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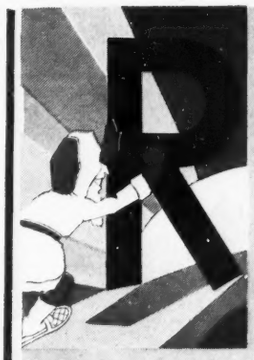

Refrigeration is essentially a tool of food processing; not solely a means of food preservation. + Refrigeration firms meat for cutting, aids beverage carbonation, hardens candy coatings, chills lard, and fills other indispensable roles in food processing. + Its function in these cases is quite distinct from spoilage prevention. ◆ Quick freezing creates a new technology and new distribution problems. + It is preservation by cold at its best, yet it should not and cannot be used for all perishables. + Food manufacturers should understand refrigeration and use it more widely. ++

MAY
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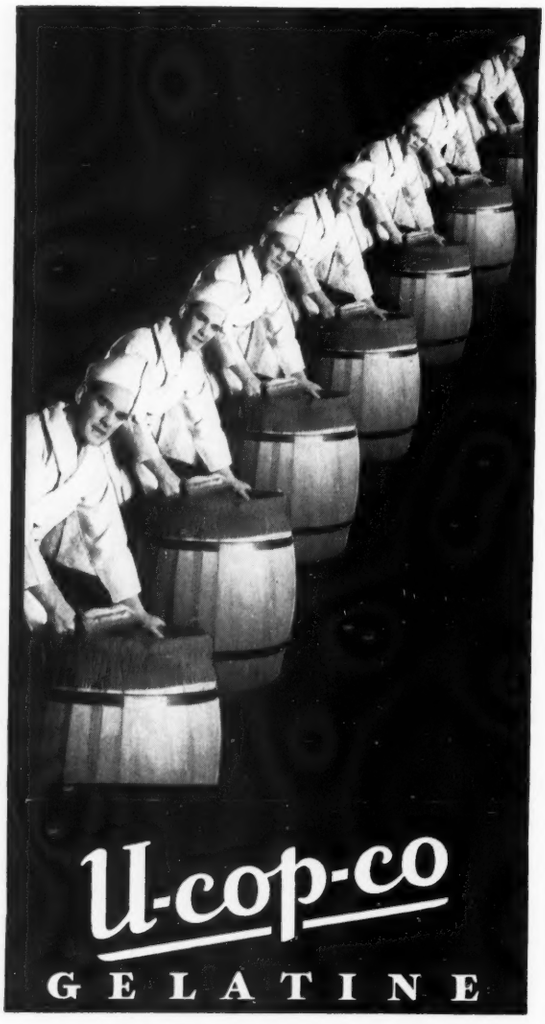

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FOOD INDUSTRIES

NUMBER 5

The Journal Devoted to the Problems of the Food Manufacturer

Refrigeration and Frozen Foods Number

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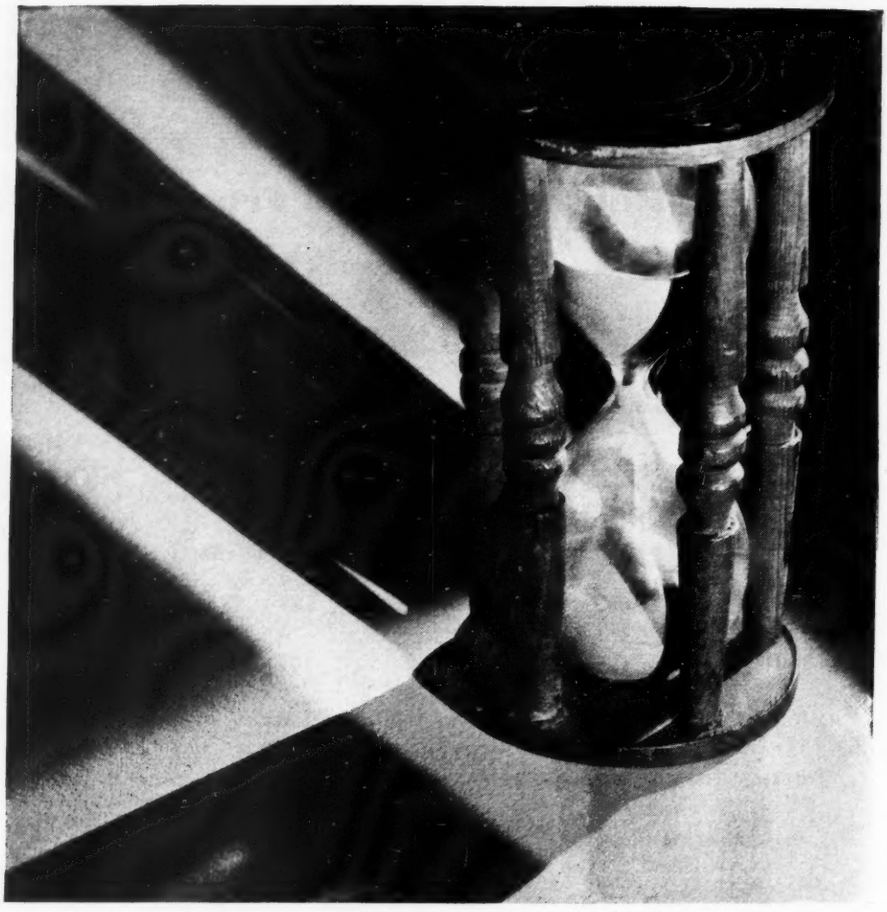

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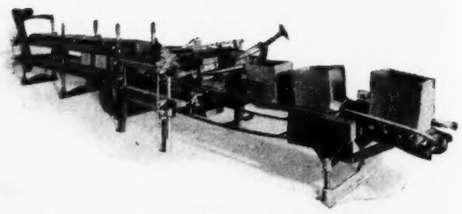

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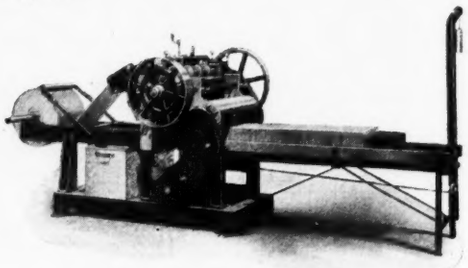

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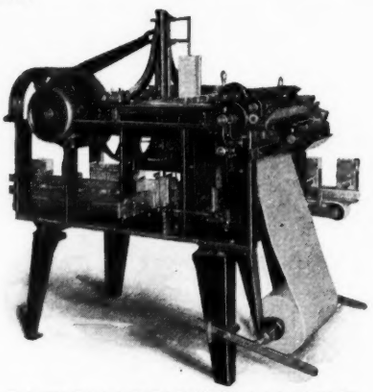

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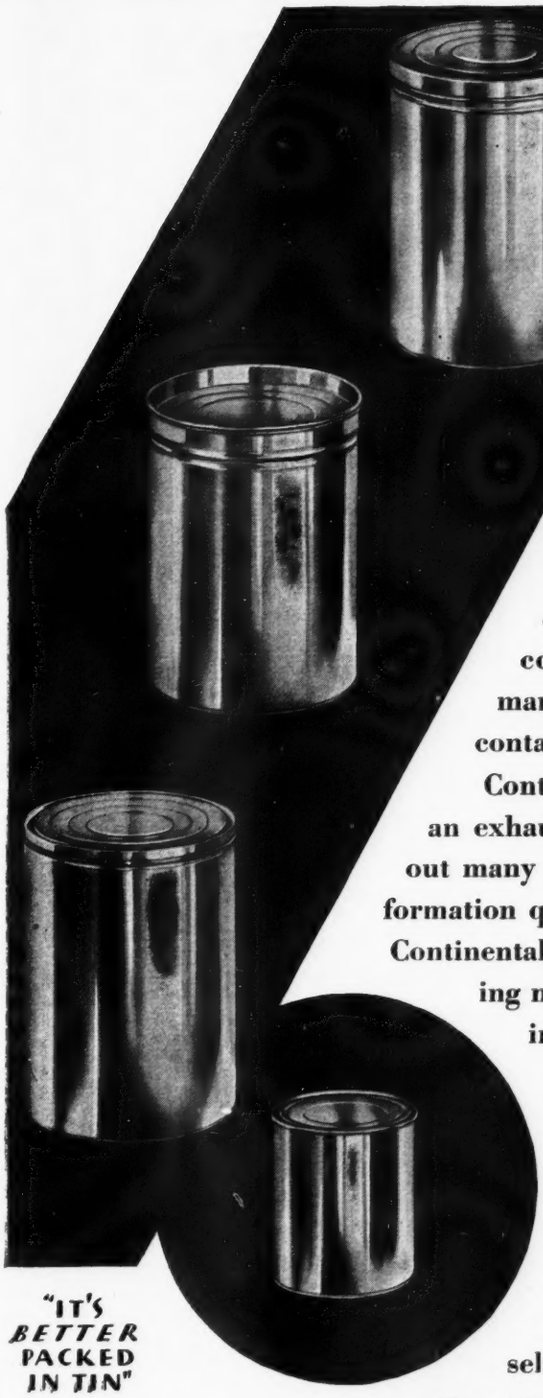

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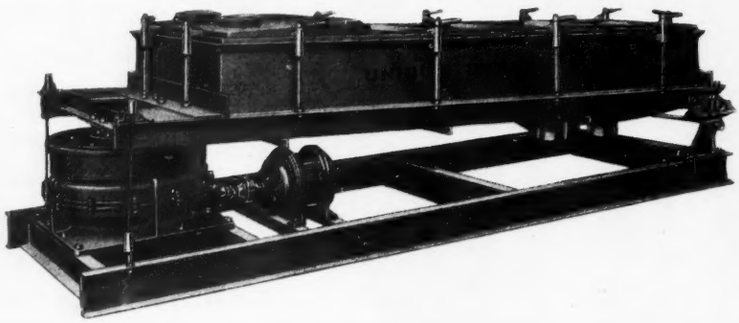

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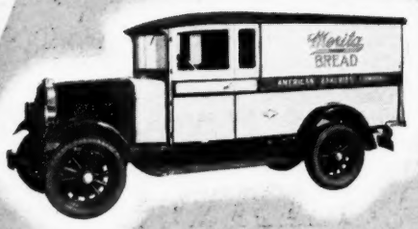

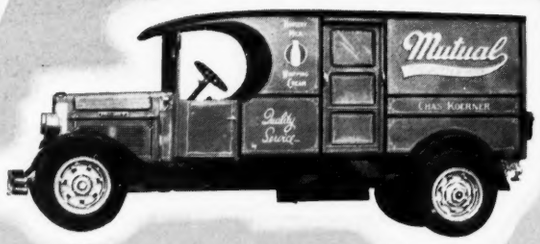

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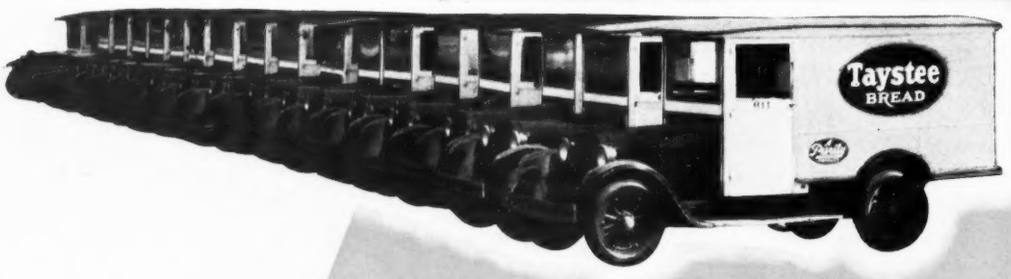

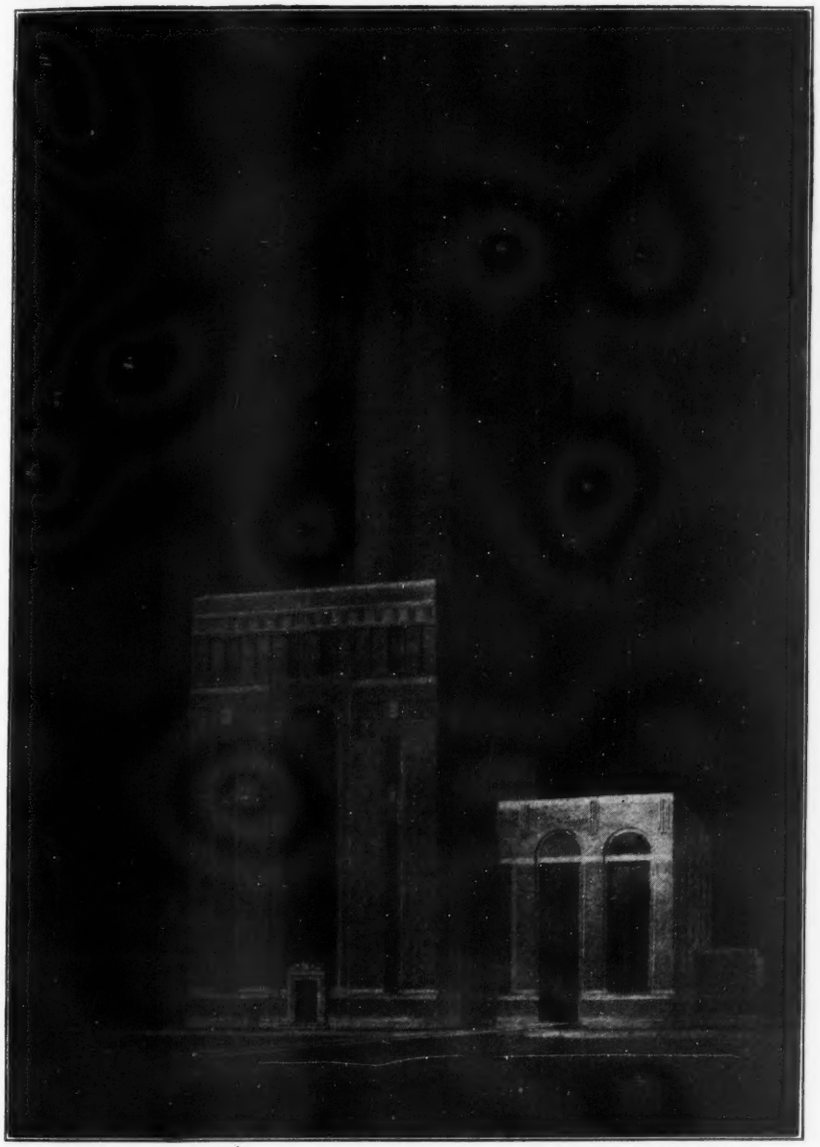

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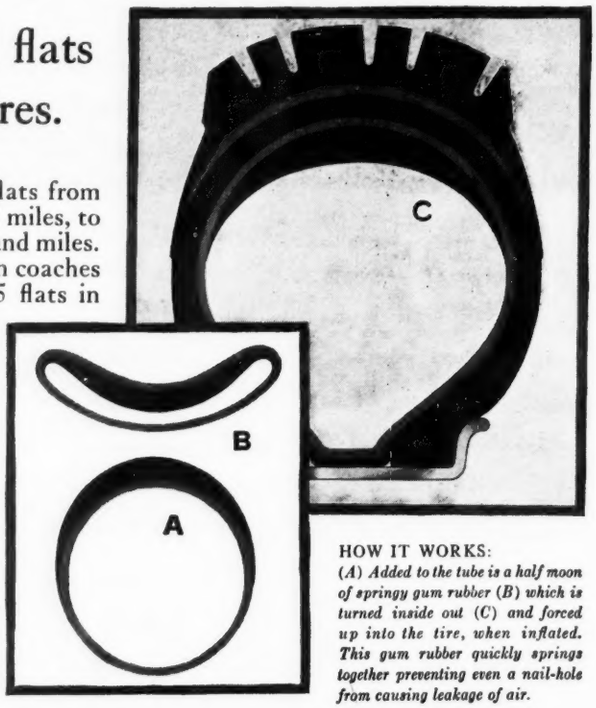

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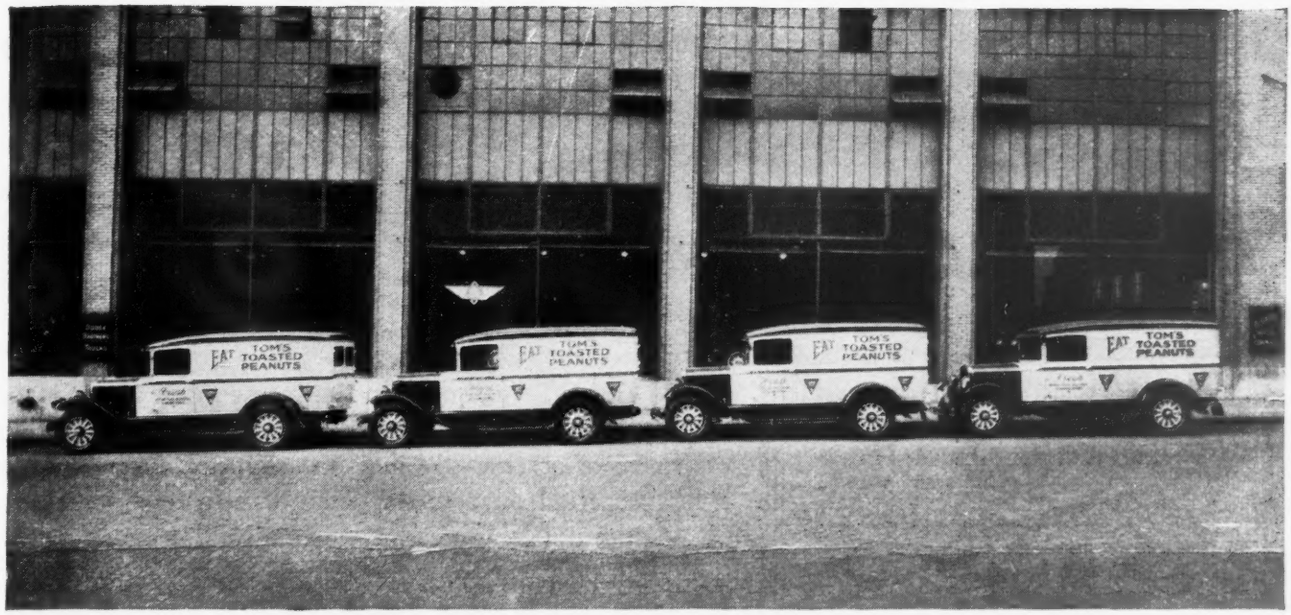

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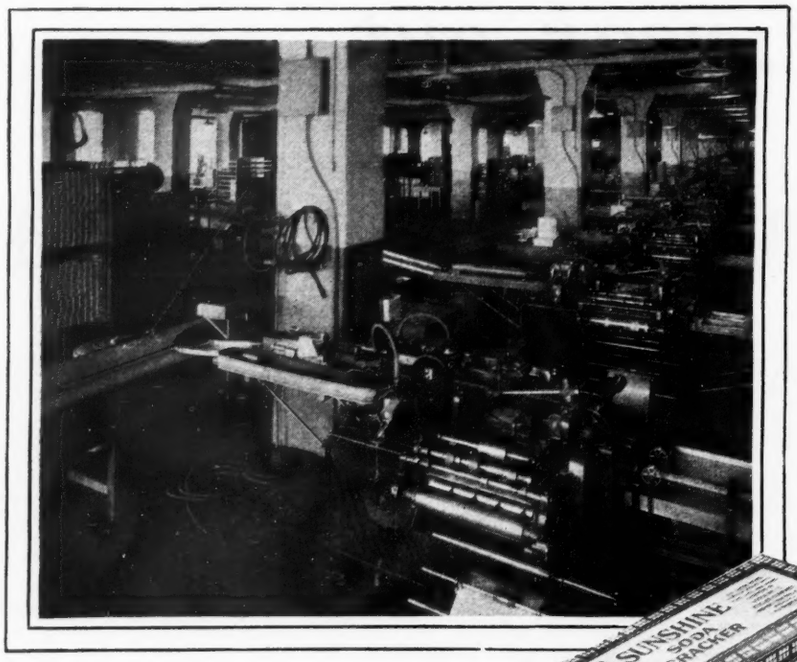

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FOOD INDUSTRIES

The Journal Devoted to the Problems of the Food Manufacturer

Volume 3.....A McGraw-Hill Publication—Established 1928.....Number 5

NEW YORK, MAY, 1931

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Laurence V. Burton, Editor

Keeping Pace With Refrigeration

AS THE USE of refrigeration grows in diversification and importance, it is necessary to maintain our sense of the relative value of the many applications of heat-removal methods. Even those who employ this useful tool of food processing sometimes lack a complete understanding of what refrigeration really accomplishes.

TECHNOLOGY OF REFRIGERATION must not be confused with technology of freezing, for freezing is a change of state of matter brought about by lowering the temperature. Likewise, one must keep clearly in mind the purpose to be attained when using refrigeration.

MANUFACTURERS OF LARD and shortenings would produce greasy, unattractive products were they not put over the chilling rolls before packaging. Bottlers of carbonated beverages need refrigeration to increase the solubility of carbon dioxide in the water before filling their bottles. But in neither of these cases is the particular use of refrigeration primarily for preservation. A long list of non-preservative users of refrigeration could be written that would include also the confectioner, the baker, the meat packer, the gelatin manufacturer, the ice cream maker, the butter maker, and others. In all of these instances refrigeration has an indispensable function that is quite apart from that of food preservation, although low temperatures may be necessary for proper subsequent storage.

PRESERVATION BY COLD also has a tremendously wide application throughout the food industries, but frequently there exists a misconception of the true function of cold in this process.

LIFE ITSELF is the greatest preservative known, and as long as life exists it protects tissues against decomposition. Animal tissues when removed from the body are dead tissues and are readily attacked by micro-organisms, and hence refrigeration is used because it has a direct action in restraining micro-organic life; but in the plant tissues life persists for long periods after harvesting, and as long as they are healthy they possess the power to resist attack.

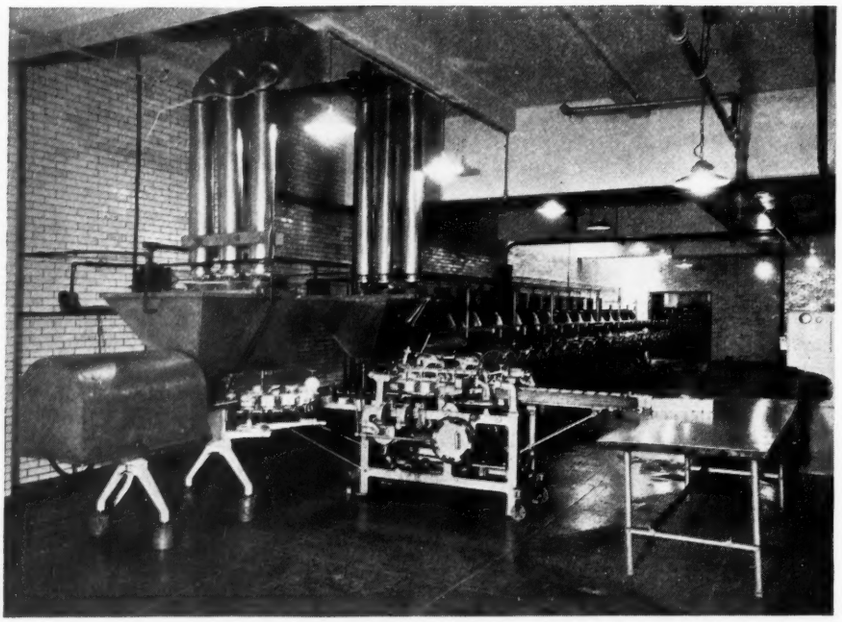
IN THE COLD STORAGE of fruits and vegetables the purpose of refrigeration is thus an indirect function of preservation. Life is the preservative; refrigeration is only to restrain the speed of the life process to the irreducible minimum, for when life goes out, the perishable will quickly lose its usefulness. The end of life comes to many vegetables and fruits at temperatures distinctly above the freezing point, and hence the need of accurate control and proper ventilation.

QUICK-FREEZING is one of the most improved applications of refrigeration as a means of preservation, yet a careful study of the article by H. F. Taylor in this issue will reveal the need for further intensive studies in colloid chemistry for a complete understanding of what takes place when, as well as after, products are frozen. In the present state of our knowledge, quick-freezing cannot be successfully used on all perishables. For example, the frozen tomato becomes a watery mass on defrosting, irrespective of the speed of freezing

ECONOMICS, IN THE LONG RUN, is the factor that will largely determine with what products preservation by the improved technique of freezing will be a commercial success. Where freezing as a means of preservation brings greater satisfaction to the consumer through improved quality or lowered prices, it will find a permanent place in the general scheme of food processing.

Proper Application of Refrigeration Controls Ice Cream Quality

By A. H. BAYER
Director, Research and Production
General Ice Cream Corporation,
Schenectady, N. Y.



Packaging and freezing departments in an ice cream plant, showing fifteen 40-qt. brine freezers, two automatic packaging machines, and one automatic package-wrapping machine

REFRIGERATION is essential in manufacturing ice cream and also is important in controlling that part of the quality of ice cream known as the texture, or body. A good-textured ice cream should be smooth and yet not so smooth as to be soggy. Texture in ice cream is of sufficient importance to be valued at 25 points out of a possible 100-point score. Furthermore, poor texture in ice cream often spoils good flavor. While I stress the importance of refrigeration, there are many other factors which influence texture. Some of these are the composition of the mix, ingredients used, physical condition of the homogenizer and its valves, homogenizing pressures, physical condition of the freezers, freezer dasher and blade construction, and the handling of the product between the mixing vat and the hardening room. In spite of these other factors, improper application of refrigeration will bring defeat, though they all be properly applied.

Refrigeration is needed in a number of operations in an ice cream plant. Its three most important uses are: cooling the ice cream mix, freezing the ice cream mix into ice cream, and hardening the ice cream. Other uses for refrigeration include cooling packaging-machine hoppers, cooling hoppers used for can filling, fruit storage rooms, and cream storage rooms.

To cool the pasteurized mix, which has been heated to 150 deg. F., to a temperature of 40 deg. F., necessitates reducing it 110 deg. of temperature, which is done by passing the mix over surface coils or through internal tubular coils. In either case there are two sets of coils, one containing water and the other the refrigerant, either brine or ammonia. The water reduces the temperature of the mix from 150 deg. F. to between 80 and 90 deg. F., depending on the temperature of the water. The refrigerant then cools this mix to 40 deg. F. The use of water plus a refrigerant is economical and it also permits gradual cooling of the mix, instead of a rapid shock from 150 deg. F. to the temperature desired. The important thing in cooling is to reduce the temperature of the mix from 150 to 40 deg. F., gradually though quickly, without shock; and a good operation should have ample refrigeration and cooling surface to do this. The requirements are dependent upon the amount of mix and the number of degrees to be taken out of the mix in given time.

Example

Requirements for cooling 5,000 lb. of mix an hour from 150 to 40 deg. F.

1. If this were done entirely with a brine surface cooler: 150 — 40 = 110 deg. F. required taken out of the mix, 5,000 lb. mix × 110 = 550,000 heat units to be removed.

Since one ton of refrigeration = 12,000 B.t.u. per hour, 550,000 ÷ 12,000 = 45.8+ tons of refrigeration necessary.

2. However, since we use water to reduce mix from 150 to 80 deg. F., to further reduce it to 40 deg. F. with the refrigerant we need only to take out 40 deg.; 5,000 lb. mix × 40 = 200,000 heat units to be removed; 200,000 ÷ 12,000 = 16. 6+ tons of refrigeration needed.

The above calculations, although not technically accurate, are sufficiently accurate for practical application. It will be noted that the use of water cuts the tonnage requirements to approximately 36 per cent of the original requirements.

With this brine surface cooler, 20 sq.ft. of surface is considered adequate to reduce 1,000 lb. of mix per hour through a range of 50 deg. F. This is a normal average and there are many factors, such as the number of coils, length of coils, type of brine cooler, and method of storing brine, that change the above figures. For direct expansion surface coolers, 8 to 10 lin.ft. of 2-in. direct-expansion coil per ton of refrigeration is considered adequate. However, here again such factors as installation and proportions of cooler make this indefinite. The higher the cooler, the greater the number of tubes, and the shorter the length of the tubes for a given capacity, the greater the efficiency. If in cooling the mix it is not cooled to a temperature very nearly approaching 40 deg. F., it will impair the keeping qualities of the mix, which means inferior flavor if kept at the higher temperature an appreciable length of time. Otherwise, it becomes necessary to cool it in the holding vat, which requires additional time and extra refrigeration tonnage. This is expensive and tends to beat up the mix, since it must be kept under agitation while cooling.

Holding vats are not intended for cooling but merely to maintain the mix at a temperature of approximately 40 deg. F. until ready to be frozen. Such vats, provided they are properly insulated and sealed, will hold mix for eighteen hours with not more than a 5 deg. rise in temperature, without any refrigeration. However, refrigeration is applied as either brine, ammonia, or, in some isolated cases, ice; and the refrigerant is either passed through a coil

or impeller in the mix, or in a jacket surrounding the mix.

Refrigeration is needed in the ice cream industry principally for freezing the ice cream mix and for hardening it in the hardening room. In the process of freezing, the liquid ice cream mix is reduced from a temperature of 40 deg. F. to a semi-solid mass at 23 deg. F. It is drawn into cans and packaged at this temperature, but must be reduced to a temperature of zero, or lower, before it is ready for distribution.

The important thing in these processes is to make this interchange of heat as rapidly as possible, and to attain the temperature of zero in the shortest possible time. Ice cream mix, containing approximately 60 per cent of moisture, unless frozen and hardened quickly, will permit of this moisture freezing into small ice crystals; or, it will permit of the grouping together of the milk sugar crystals. The formation of ice crystals produces an "icy" or "coarse" textured ice cream, whereas the grouping of the milk sugar, occurring in abundance, produces crystals in ice cream, causing what we term "sand." Both are objectionable in the production of a quality product.

The freezing process consists of whipping the mix in a cylindrical, jacketed machine surrounded with either circulating brine or ammonia. In this process there are two steps: the freezing and the whipping periods. In the freezing period the refrigerant should take out 18 deg. of temperature, from 40 to 22 deg. F., in not over 5 to 6 minutes and produce a mixture of proper consistency. The whipping period, which follows with the refrigerant shut off, should be short and not over 3 to 4 minutes, to give to the ice cream the desired body. Too long a whipping period, after refrigeration is shut off, will undo the good of rapid freezing, in that it will raise the temperature above 24 deg. F. and produce a "soupy," or soft, ice cream. Ice cream should be drawn from the freezer at a temperature not over 23 deg. F.

The first refrigerant mentioned (brine) is most commonly used today. In order to obtain the desired results this refrigerant should be at a temperature of from —5 to —10 deg. F., and it is advisable to lower this temperature under certain conditions. However, temperature is not enough. It is necessary to have sufficient brine volume: that is, a large enough volume of brine circulating through the jacket of the freezer to remove and carry off the heat units as rapidly as possible. In order to do this properly a good rule is to have 4 gal. of brine per minute circulating through the freezers for every gallon of ice cream mix to be frozen in the freezer at any one time. It is also advisable to have approximately 3 tons of refrigeration for every 40-qt. freezer in the plant, for freezing purposes only.

Direct expansion is the method of circulating ammonia directly through the freezer jacket and is coming into common use very rapidly. It has many advantages. In this operation it requires about 5 tons of refrigeration at a back pressure of 15 lb. for every 40-qt. freezer in the plant. However, whatever the refrigerant, the principles of low temperatures and sufficient volume with ample tonnage are necessary to do a good job, which means drawing ice cream from the freezer at 23 deg. F., firm, and in as short a time as possible; preferably 5 to 6 minutes. An ice cream frozen quickly and whipped a minimum length of time will be much smoother in texture than one which requires long freezing or whipping time, or both.

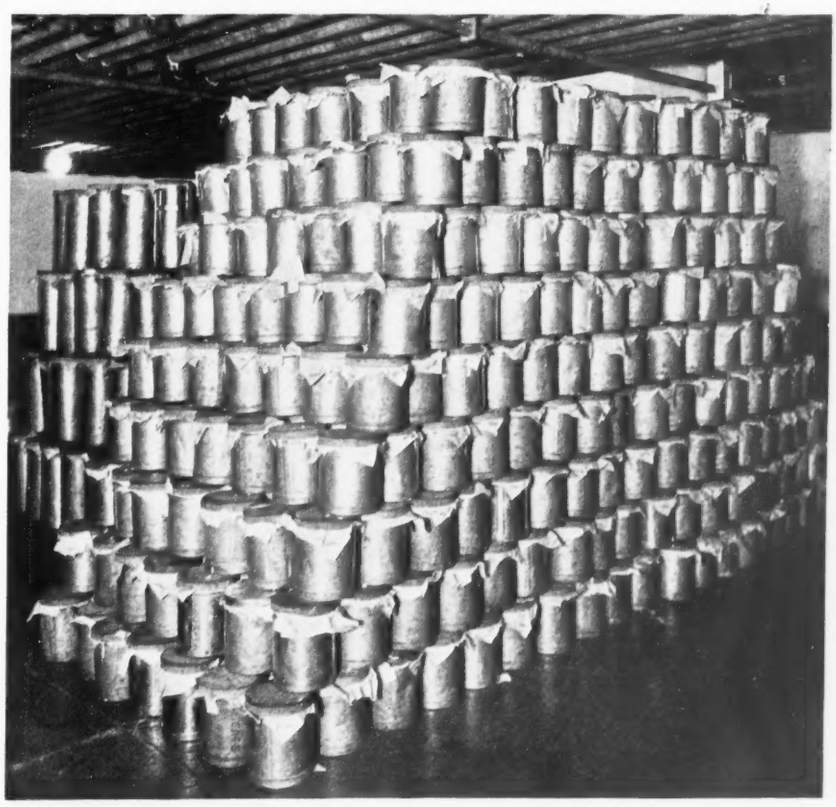
Having frozen the ice cream to a temperature of 23 deg. F. it must be hardened to a temperature of zero as quickly as possible. Now, slow hardening after freezing has a most vital effect on the texture of the ice cream, as pointed out above. Ice cream should be at a temperature of zero in ten hours or less, after being placed in the hardening room. The first thing to consider is room temperature. The hardening room should be between —10 and —15 deg. F. However, a room with these temperatures will not give desired results if the air in it is not circulated.

Air in circulation in a room of such a temperature is much more effective than still air in a room 10 to 15 deg. lower. Experiments recently have proved that air circulation reduces the hardening time from 50 to 75 per cent. It is likewise essential to pile the ice cream so that there is an air circulation around each can. I have known ice cream in the center of large piles in —10 deg. F. room not to harden to zero in 48 hours. Ice cream hardened slowly will not be as smooth as ice cream hardened rapidly. The old blast system, now almost obsolete, of cooling the air and then blowing it through a room void of coils was efficient in this respect.

The newer systems, consisting of overhead coils or shelf coils, should have sufficient surface in piping, with ample refrigeration behind, to maintain temperatures. Installations are made having from 1 lin.ft. of 1¼-in. pipe for every cubic foot of room space, to 1½ lin.ft. of 2-in. pipe, depending on the size of the room. The larger the room, the less linear feet of piping per cubic foot needed. The more modern construction will call for plenty of headroom to use 2-in. coils on not less than 6-in. centers. Even a greater space between centers is desirable for better circulation, which means lower temperatures and less frosting. The flooded system is now being widely adopted in new installations. Other systems consist of the circulating of liquid ammonia by means of special pumps. Details of all systems vary according to specifications of various manufacturers.

In conclusion, it is sufficient to say that unless refrigeration is adequately supplied and properly applied in cooling, freezing, and hardening, regardless of how much care may have been taken in all other matters, an ice cream of inferior quality will be the result.

Notice the staggered piling of cans to allow air space between cans for air circulation in this hardening room of an ice cream plant



Temperature Control In Ripening Cheese

By R. L. FLINT
Manager, Grove City Creamery
Grove City, Pa.

RIPENING of cheese is a bacteriological and chemical reaction influenced by temperature and time, plus many additional factors, depending upon the variety of cheese. Aside from improvement in quality of milk, progress in stabilizing quality in cheese has advanced in the degree that makers have learned to co-ordinate the control of temperature, bacteria, and molds. The texture and flavor of cheese are influenced to a large extent by its ripening. Many types of bacteria are present in cheese curd, some of which may be introduced by the maker as an aid in developing the desirable features in the kind made. All are influenced by the temperature and humidity at which the cheese is held. Refrigeration or temperature control, therefore, is an important feature in ripening cheese. The term "refrigeration" as here used refers to temperatures above rather than below the freezing point, as freezing is generally considered detrimental to its texture.

At the Grove City (Pa.) plant, two foreign types of cheese are made, Roquefort and Swiss. Camembert and Chaddar have been made to some extent at various times. In planning rooms and refrigeration adapted to various types, some of which would be mold cheese and some not, some of which would require high relative humidity and others less, an air-cooling system seemed most desirable, as where high humidity is maintained there is a heavy condensation on expansion or brine coils. Also it was not only desirable to regulate the cheese-curing conditions but to prevent the mold from one curing room from mixing with the air of another and thereby causing trouble.

The system installed combines temperature and humidity control and an air-washer, with a fan for circulating the cooled air in a closed circuit throughout the rooms. A series of rooms are insulated on the sides, tops, and bottoms with 4-in. cork, and an insulated chamber adjoining contains the water sprays and cooling unit.

The cooling unit is a set of direct-expansion ammonia coils, made in three sections, each section ten pipes high and 7 ft. long, made of 2-in. pipe, galvanized on the outside.

The air washer consists of a series of sprays, through which the air is drawn on its return from the curing rooms. The washer is so arranged that the water for the sprays falls over the direct-expansion coils, which cools it to about 32 deg. F. Below the coils is a storage tank, from which the water is forced through the sprays by a rotary pump. Between the sprays and the fan is a series of baffle plates, to prevent the water from passing out with the air. Insulated ducts carry the air into the curing rooms through the ceilings. Two inlets are provided for a room 11x19 ft. At the opening of the air conduits in the rooms are dampers. Four outlets in the ceiling of each room connect with a common duct, which returns the air to the washer. This system assures a thorough circulation of air in the room.

The air leaves the washer at a temperature of 40 to 45 deg. F., and in a saturated condition. As the air mixes with the warmer air of the curing room, the relative humidity drops and it is necessary in some cases to bring it to the desired point by introducing additional moisture. This is done by blending steam with water by the use of jets in the coolers.

The refrigerating unit is guaranteed to lower the temperature of 3,500 cu.ft. of air per minute from 60 deg. F. dry bulb and 51 deg. F. wet bulb to a dew-point temperature of 40 deg. F. when the equivalent of 8 tons of refrigerating effect is supplied the cooling coils. An expansion coil is installed in one of the rooms, so that ripened cheese can be held at a temperature below that practicable with the air-cooling system installed.

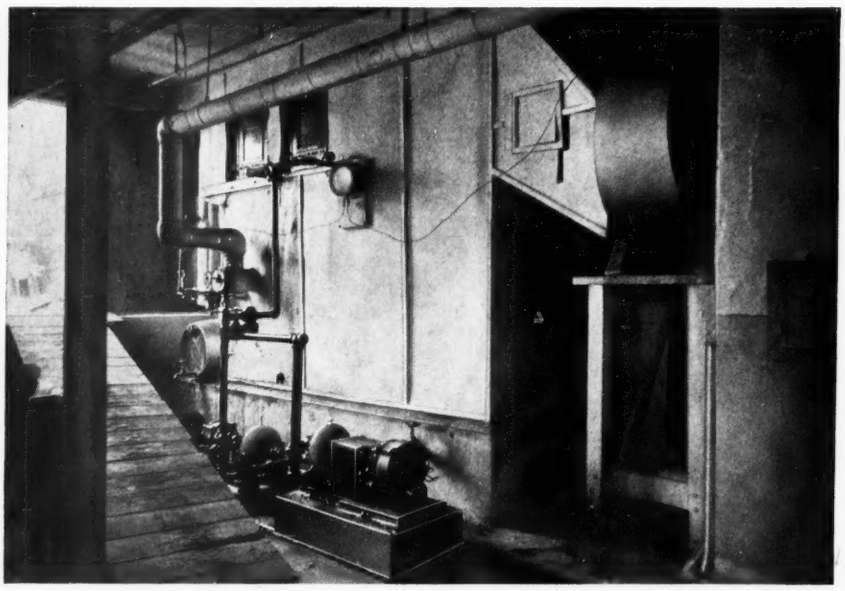
Generally speaking, when cheese is held at too high a temperature during ripening, an over-acidity is developed which results in a sour-flavored product; if the atmosphere is too moist, molds are likely to develop which act on the fats and produce a rancid flavor; when the atmosphere is too dry, there is an evaporation of the moisture, resulting in an excessive thickening of the rind and a loss in weight and texture. When held too high, bacterial and enzymic action is retarded and flavor develops slowly or scarcely at all.

Speaking specifically of Roquefort, when held at too high a temperature, the cheese surface becomes overrun with an air-borne contamination of yeast and molds, and the curd breaks down or ripens too rapidly, producing a body that is salvy and oilly in texture. Without proper temperature control it is impossible to check the Roquefort mold at the right point to obtain the maximum of desirable flavor and aroma. During the early stages of ripening, a temperature of from 45 to 50 deg. F. is desirable, with a relative humidity of 83 to 90. Later the temperature should be lowered to approximately 40 deg. F., with a relatively lowered humidity. When fully ripened, a temperature slightly above freezing is desirable, and the cheese should be so packed that the evaporation will be as low as practicable.

In the ripening of Swiss, a fairly high temperature is desirable during the early stages—approximately 70 deg. F.—so that the eye-forming bacteria may remain predominant. Later the temperature is reduced to approximately 40 deg. F., in order to obtain proper blending of the influences that develop the qualities characteristic of this type.

For slow-ripening cheeses like Requefort and Swiss, requiring from 4 to 6 months to cure properly and subject to normal temperature fluctuations throughout the period, plus the hazards of exterior contamination and interior developments, it is highly important that proper temperature and humidity control be provided during the ripening process.

Equipment use for control of humidity in Roquefort cheese curing



Storing Fruits and Vegetables By Refrigeration

By E. L. OVERHOLSER
Professor of Horticulture, State College of Washington
Pullman, Wash.

METABOLIC changes of most plant tissues are most active at from about 75 to 95 deg. F. Any lowering of these optimum temperatures is followed by a retardation of the life processes. Since these metabolic activities require energy that is obtained by oxidation, respiration, of the food materials within the tissues of the products, and since low temperatures retard these metabolic activities, the "life" period is correspondingly prolonged.

The basic fact, therefore, upon which cold storage practice in the retention of fresh fruit and vegetables depends is that the chemical reactions and physical processes which accompany the attainment of over-ripeness and senescence are retarded with a drop in temperature.

There are three general methods of providing storage temperature: (1) By ventilation, using the lower temperature of the outside air for cooling; (2) by the use of ice; (3) by mechanical means.

Common Storage—In common storage, ventilation with the outside air is relied upon to cool the contents of the storage building. It is feasible in the Northern states for temporary retention of produce in fall and early winter, when the outside temperatures are cool.

Systems of Cold Storage—There are two systems of refrigeration in cold-storage plants: ice and mechanical refrigeration. Commercial cold-storage rooms are now nearly always cooled by some form of the latter method. By mechanical means, refrigeration may be produced by the evaporation of a liquefied gas which in evaporation absorbs heat from its surroundings. The refrigeration gases generally used are anhydrous ammonia, sulphur dioxide, and carbon dioxide.

Among other things, four fundamental factors of the cold-storage room involved in the successful retention of fruits and vegetables are: (1) relative humidity; (2) air circulation and ventilation; (3) composition of the atmosphere; and (4) temperature.

Relative Humidity—If the relative humidity is too low, there is undue wilting and shriveling of the commodities, because of loss of moisture by transpiration. This is especially true if the air currents are pronounced. On the other hand, the relative humidity should not be excessive. If so, moisture may precipitate out in the form of droplets of water upon the material, and mold growth and rot be favored. Definite information is lacking as to the optimum relative humidity for the various fruits and vegetables. In general, however, the relative humidity is maintained between 85 and 90 per cent, or as near 88 per cent as is feasible.

Air Circulation and Ventilation—The term "air circulation" is used to designate air movement within the storage chamber, without the introduction of outside air. Ventilation refers

E. L. Overholser

to the practice of introducing fresh outside air into the storage chamber. Good facilities for both practices prevent an accumulation of carbon dioxide, resulting from respiration of the fruit, or of the vapors of esters, or volatile fruit oils and similar products which are given off by fruits and vegetables and may affect them deleteriously if the concentration becomes too great.

Composition of Storage Atmosphere—Normal air is a mixture of gases, the chief constituents of which are nitrogen, about 79 per cent; oxygen, about 21 per cent; and carbon dioxide, about 0.04 per cent. Oxygen is essential for fruits and vegetables so that respiration, or the combustion of substances in the commodity tissues, may proceed, whereby the energy necessary for the maintenance and further ripening of the tissues may be produced. The oxygen must not be permitted to drop too low in closed chambers.

Carbon dioxide, one of the products of the combustion in the tissues, in small quantities tends to stimulate metabolism. Large quantities act as a depressant of metabolism, and excessive quantities are injurious to the tissues. A quantity which is neither too large nor too small may, therefore, retard metabolism. Since, as a result of their metabolism, fruits and vegetables consume oxygen, and give off carbon dioxide, it is possible for these commodities to modify the composition of the surrounding atmosphere by lowering the oxygen and increasing the carbon dioxide.

At cold-storage temperatures carbon dioxide is more toxic to plant tissues than at high temperatures. Hence, it is necessary to provide for the introduction of sufficient outside air to prevent too profound a modification of the composition of the atmosphere.

Temperature—Since the actual freezing point of most fruits and vegetables is not above 29 deg. F. it would appear, if temperature control was sufficiently accurate, that storage at about 30 deg. F. would result in a maximum retardation of ripening and in the longest keeping period for the fruit. With many fruits and vegetables this is the case.

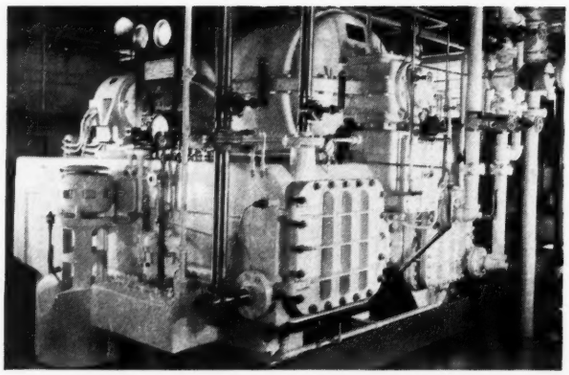
It should be pointed out, however, that generalizations concerning the "optimum" storage temperatures for fruits and vegetables are not possible. By storage at temperatures as low as 30 to 32 deg. F. it is believed that the course, or character, or balance of metabolism, or ripening changes is affected as well as is the degree of retardation of these changes. This disturbance of the balance may bring about deleterious effects which make it difficult to determine a single optimum storage temperature for the greatest retardation of metabolic processes of all fruits and vegetables.

The most satisfactory storage temperature, therefore, generally is one that will result in the most complete checking of further changes, without disturbing the normal character of metabolism to too great a degree. Each 15 deg. F. drop in temperature, down to the point at which this disturbance or freezing results, cuts the rate of ripening approximately in half. Hence, the lower the temperature at which the products can be kept without possible injury, the longer the material can be kept marketable in a fresh condition. For most deciduous fruits and with many vegetables, except for certain varieties of both grown in a few sections, this temperature is from 30 to 32 deg. F. With tropical fruits, such as bananas and avocadoes, successful storage is at higher temperatures—about 60 deg. F. for the former and 40 deg. F. for the latter. When bananas are stored at refrigerator temperatures the skins blacken. Irish potatoes for sale to the retail trade are not kept at a temperature below 36 to 38 deg. F., because at lower temperatures a disturbance in the balance brings about an accumulation of sugars, giving an abnormal sweet flavor when cooked. This sugar accumulation is corrected if the potatoes are kept for a time at room temperatures after removal from storage temperatures that are too low.

Refrigeration Expands Beverage Industry

By Courtesy of

HOFFMAN BEVERAGE COMPANY
Newark, N. J.



A 94-ton refrigeration unit of the centrifugal type

A MECHANICAL refrigeration unit is an important and indispensable part of the installation necessary for the production of carbonated beverages; without it, quantity production would be impossible.

It has made possible the development of new beverage products made directly from fresh fruits and natural perishable materials. Storage of the delicate materials from which these natural-flavored beverages are made necessitates cold-storage rooms of large capacity. They must be of such size that they can take care of the fruit necessary to meet immediate production needs and the storage of such fruit as has been purchased at an advantage in market price.

Refrigeration in these rooms is commonly accomplished by means of direct-expansion coils mounted on the walls, connected to a refrigeration machine using carbon dioxide or ammonia as the working substance, preferably carbon dioxide. Temperatures are maintained slightly above the freezing point of water, in order to inhibit the growth of fruit worms, parasites, or micro-organisms that might cause deterioration and decay. It is important that the fresh fruit be not subjected to freezing temperatures and that the atmosphere be maintained as dry as possible.

Mechanical refrigeration is used also for cooling syrups and fruit juices when production demands the use of a piece of equipment, such as a cooler, to maximum advantage. In this application the syrup or fruit juice is passed through a cooler having well-proportioned heat-exchange surfaces, separated from the cooling medium by thin walls of suitable metal. The cooling medium in this instance usually is either cold water or cold calcium chloride brine, depending on the efficiency of the cooler, the material to be cooled, and the time in which cooling is to be accomplished.

Those familiar with processes involving the carbonating of water know that, in general, the volume of carbon-dioxide gas absorbed by water is dependent upon the temperature of the water entering the carbonator, the gas pressure in the carbonator, and the time interval during which the water is in intimate contact with the gas. Without going into the details of carbonation it is sufficient to say that practical requirements necessitate introducing the water into the carbonator at about 33 deg. F. Since it is advisable to deliver water to the carbonating unit at a constant temperature of 33 deg. F. and in most beverage plants the temperature of the incoming process water is a variable, dependent on seasons, it follows that the demand for refrigeration will vary accordingly. Coupled with other uncontrollable factors, such as seasonal stock depletions, with consequent production peaks, and unavoidable losses, the plant operator is likely to find himself severely handicapped in trying to meet demands efficiently unless the apparatus has been carefully selected for size of individual units and total tonnage.

The water cooling may be accomplished by any one of several methods, depending upon local conditions and the quantity of water to be cooled. Some plants find it advantageous to pass the water into sanitary tanks in which have been installed cooling coils. Refrigerated calcium-chloride brine is circulated through the coils and a heat transfer is effected. The water usually is mildly agitated to induce circulation. Small plants may resort to a system of pipe coolers, where the refrigerant is directly expanded to the inside of the pipes and the process water is caused to flow over the outside surfaces of the pipes. After effecting the heat transfer, the water may be collected in a suitable vessel and passed, in some conventional manner, to the carbonating units.

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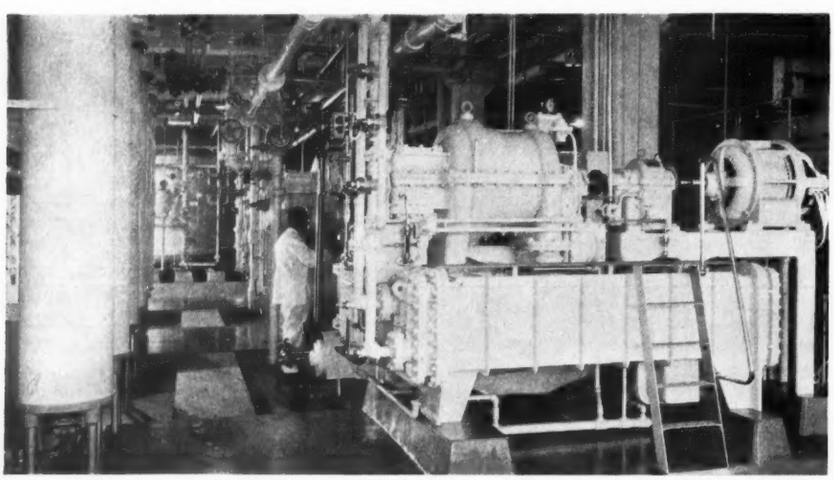
Only a careful analysis of local conditions will decide the type of mechanical refrigeration to be used, size of units, and the method for obtaining the cooling desired.

While the refrigeration units themselves may be chosen by giving due consideration to the usual factors involved, the exacting requirements of the manufacturer of quality beverages, for cleanliness, sanitation, and quality control are met only through special or modified designs of standard cooling equipment.

Centrifugal refrigeration units at Hoffman Beverage Company plant



Concentrating Fruit Juices By Freezing

By M. G. WEBER
Consultant, Orlando, Fla.

IN order to reduce the bulk of fruit juices by the elimination of water, two methods can be employed: concentration by heat and by freezing.

Utilizing heat under vacuum for concentrating purposes is a general commercial practice. However, the product thus obtained usually is lacking in flavor when diluted again to the original strength, unless the fruit esters removed by vacuum are returned. Furthermore, most heat concentrates possess a more or less cooked taste. When concentrating fruit juices by freezing, the original taste is preserved, because the natural esters remain in the product.

According to the laws of nature, over six times as much energy is required to evaporate a certain volume of water as to solidify the same quantity by freezing. In practice, however, the freezing process so far is at a disadvantage, because in order to arrive at the same concentration as is obtained by one single heat-vacuum treatment, the fruit juice must undergo several consecutive freezings, which procedure is much more costly, on account of the greater amount of handling necessary due to repeated operations and on account of the loss of energy due to the indirect method of producing cold.

Various freezing processes have been worked out in the past. A process was perfected by Professor Monti, of Italy, over twenty years ago. By this method the fruit juice is transformed into a slush stage, yielding small ice crystals and concentrated fruit syrup. The soluble matter between the ice crystals is extracted by drainage and by replacing it with dilute concentrates of previous charges. The process is in commercial use in Italy.

H. C. Gore, formerly of the Department of Commerce, now of Fleishman Laboratories, suggests freezing cider in regular 300-lb. tin-lined ice cans, such as are used for commercial ice production. The fruit juice is frozen solid at 10 to 20 deg. F. in the course of 36 to 48 hours, after which time it is removed from the metal container, passed through an ice crusher in order to disintegrate the solid ice cake, and centrifuged for the purpose of separating the concentrated fruit juice from the ice. This fruit syrup is not sufficiently concentrated and must be refrozen in the same ice cans at a temperature of 0 to 10 deg. F. during two or three days. The contents of the ice cans after the second freezing is of a thick, mushy consistency and yields after centrifuging a fruit syrup, one part of which when diluted with four parts of water produces a cider of approximately the original strength and flavor.

Promising results were obtained by freezing fruit juices under slow mechanical agitation, which expedites the penetration of the liquid by the cold and prevents its solidification. It yields a mass of fine ice crystals intermixed with concentrated fruit juice, which is easy to manipulate. An agitator speed of 20 to 30 r.p.m. was found to be of advantage. Previous to the freezing operation the fruit juice must be clarified mechanically, in order to remove the pulp in suspension; otherwise the freezing period is prolonged and the yield of concentrate is lower. The clarification is advantageously performed by passing the fruit juice through a slowly revolving, perforated metal cylinder. The clarified fruit juice, under continuous agitation, is exposed to brine of a temperature of 0 to 10 deg. F., which turns it into a slushy mass in the course of several hours. As soon as the proper consistency is reached, which period varies with the sugar, acid, and pectin contents of the fruit juice, the action of the brine is stopped and the crystalline mass centrifuged in order to separate the concentrated juice from the ice crystals. The centrifuging should be performed at a temperature of approximately 28 deg. F. The partly concentrated fruit juice is re-frozen in the same manner two or three times, with the result that a final density of 26 to 27 deg. Bé. is achieved. The ice crystals after centrifuging still contain a small percentage of juice concentrate, which it is possible to recover by letting the temperature increase slightly and by recentrifuging the ice mass. If the partly concentrated juice thus recovered is added to a charge of juice to be frozen, the actual loss of fruit juice will amount to not more than 2 to 3 per cent.

Higher concentrations of fruit syrups are feasible by repeating the freezing operation, although undoubtedly the cost of production would be prohibitive. In order to operate economically, concentration by freezing should be carried out at a cold-storage or ice cream plant, because if a factory were to run only a few months every year during the fruit season it would never be a success.

Fruit juice concentrates produced either by vacuum-low heat treatment or by freezing are subject to spoilage, for which reason they must be preserved. Pasteurization can be resorted to for this purpose. However, this heat treatment produces a so-called cooked taste in the syrup and therefore counteracts the precaution taken so far of not exposing the fruit juice product to any heat which might impair its flavor.

Benzoate of soda will preserve fruit-juice concentrates without heat treatment, but the public has a certain aversion to it. Furthermore, fruit-juice concentrates preserved by this method should be stored at a temperature of approximately 32 deg. F., if they are to retain their original flavor longer than five to eight weeks.

Storing fruit-juice concentrates at a temperature of 0 to 10 deg. F. preserves them for a number of years without change of flavor, provided they are kept in airtight containers. This method of preserving yields a superior product and will be in general use as soon as the public is aware of its advantages.

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Refrigeration in Gelatin Manufacture

By L. M. TOLMAN
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REFRIGERATION does not play a very essential or vital part in the manufacture of gelatin, and during the winter operation, artificial refrigeration is practically of no use or necessary at any stage of its production. During the warmer months of the year, however, refrigeration becomes necessary in order to eliminate losses and operating troubles. In these months, the most important use of refrigeration is for chilling the jelly so that it may be cut before it is spread on the drying trays. In some cases this is done by chilling a belt upon which the gelatin liquor is run and running it through a refrigerated chamber, while others adopt the method of chilling it in pans to be later cut up in slicing machines.

To a certain limited extent, refrigeration is used in the matter of air conditioning of the drying rooms. As a matter of fact, the probabilities are that there will be more development along this line in the future.

In the operation of the large drying tunnels, large quantities of heated air or dry air are blown through them, and to get uniform results in such drying chambers, it is necessary to regulate the air condition. A much more uniform operation undoubtedly would be obtained if the air could be dried with refrigeration and given a uniform humidity.

However, up to the present time this has not been employed to more than a very limited extent and it is still a custom in the gelatin business to confine operation largely to the months of the year when natural drying conditions prevail. From this it can be seen that in the gelatin industry refrigeration so far plays a very minor part.

Refrigeration Expands Beverage Industry

By Courtesy of

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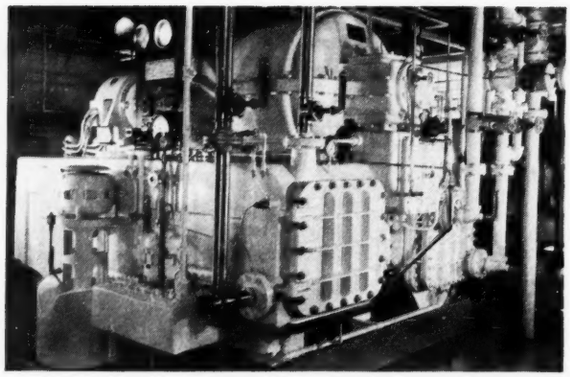

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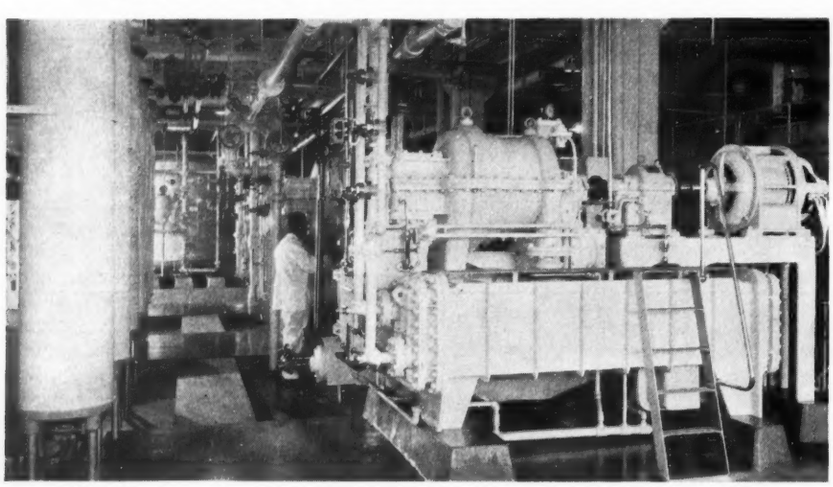

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Refrigeration Vital in the Margarine Industry

By EVERETTE I. SOLLMANN
Chief Chemist, John F. Jelke Company
Chicago, Ill.

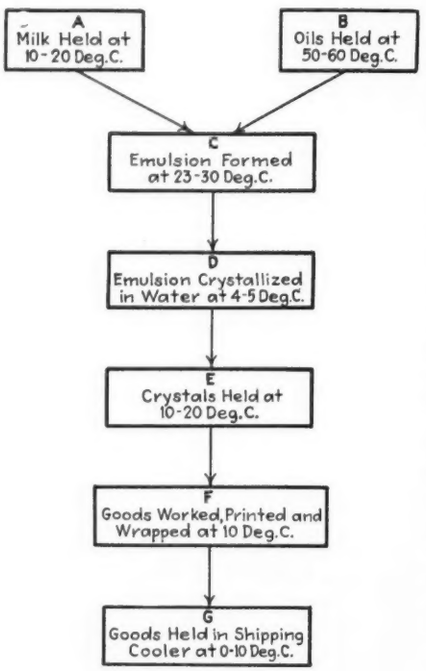
FROM the crude methods of manufacture of margarine employed at the beginning of the present century to the highly developed technical skill of the present day has been a long step, and no one detail of the progress has been more important than the proper application of refrigeration processes. To take refrigeration equipment away from the modern producer of margarine would deprive him of the instrument which makes possible the superior margarines of today.

The American and European margarine manufacturer is continually striving to produce a margarine with better frying quality, improved consistency, and butter-like taste and aroma. These qualities depend in a large measure on the type and quality of emulsion he succeeds in getting in the churning process and in the subsequent treatment of the product. With all the advances in the refrigeration art, however, some margarine churneries still today have not realized the need for refrigeration control.

In brief, then, why does the margarine industry need refrigeration? The answer is simple: it is a matter of dollars and cents to obtain better emulsions by controlling the various factors of milk and oil viscosities in churning procedure so that a higher moisture content may be obtained. American margarines are notoriously low in moisture content, far below that of butter. A higher moisture content, if properly incorporated, will result in better frying and spreading qualities, higher milk-solid content, and a greatly improved consistency. Further, if the refrigeration is properly applied, there will be no crystallization of fats (commonly spoken of in the industry as "graininess"). The temperature control of the finished product will inhibit costly oxidations which result in acrid and tallowy tasting products and growth of unsightly molds.

The accompanying chart illustrates in a simple and condensed manner the steps of the margarine process. In every step, if a highly satisfactory product is to be obtained, must correct refrigeration be applied. Procedure will vary in all plants, but the principles to be applied are the same.

In steps *A* and *B*, the temperature of the oils and milk must be carefully controlled before these two constituents enter the churn. If milk is held too cold, the temperature of the emulsion in the churn probably will go too low, and crystallization of the fats will take place in the churn. If the oils are too warm before going into the churn, the emulsion in the churn can never be brought to the correct viscosity and a product



Every step in margarine making has a definite refrigeration requirement

with too low a moisture content, bad frying quality, and poor texture will be the result. Therefore, in tempering oils and milk before churning, care must be taken to adjust properly these two components of the emulsion to correct temperatures so that they can be handled efficiently in the churn. Only by experimenting can the optimum be determined. Needless to say, optimum conditions for one formula may be considerably at variance with another formula.

In step *C*, the actual emulsification step, great care must be taken to keep the emulsion temperature at such a point where a good emulsion can be formed. This temperature will vary for each formula, but usually it is found to be somewhere between 23 and 30 deg. C.; the higher the melting point of the finished margarine, the higher the churning temperature.

In step *D*, the chilling of the emulsion into "crystals," some attention should be paid to the temperature of the chilling water. Water at 4-5 deg. C. usually is employed, but the temperature will vary some with the type of goods one is producing. Great quantities of water are needed to chill an emulsion properly by this method, so careful scrutiny of the cost records should be made for this step of the procedure. It has been estimated that fully 60-65 per cent of the refrigerating cost comes in this step, the chilling of the emulsion by the water method.

Steps *E*, *F*, and *G* are each individually important from the refrigeration viewpoint. The temperature at which the goods are to be tempered after crystallizing and before they are to be worked depends again on the individual formula and must be determined by experiment. Not enough study has been made of these phases of margarine manufacture, but it is exceedingly important to understand the "refrigeration need" of the product in each of these last steps.

At the present time it is quite impossible to state correctly the tons of refrigeration necessary per 1,000 lb. of margarine. In very few factories, the writer is informed by a refrigeration expert, has a detailed study been made of cost records for refrigeration in margarine manufacture. One American producer using a compression system for a 150,000-lb. output uses approximately 400 tons refrigeration per eight hours in the summer and only 60 to 75 tons per eight hours for the same output in the winter. The heavy cost of refrigeration in the summer is due largely to cooling water for crystallizing the emulsion, where water in the mains is at about 71 deg. F. With the advent of new and efficient chilling processes, refrigeration cost should be materially lowered.

Refrigeration incorrectly applied often brings as much or more trouble than no refrigeration at all in certain of the steps of the process outlined above. In steps *C* and *E*, if the goods are not held at the correct temperature, graininess may result. Even in step *F*, the working of margarine at too low a temperature will cause undue loss of moisture and uneven salt distribution. The holding of goods in coolers and, more important still, the temperature of the ice-box of the retailer, should be carefully watched. Goods held properly should never mold, and oxidations can be held to a minimum.

It can be said that without the advances in the art of refrigeration, the margarine manufacturer could not today be producing the fine articles of food he is offering to the public.

Refrigeration in Lard Manufacture

By J. J. VOLLERTSEN
Chief Chemist, Armour & Company
Chicago, Ill.

THE raw materials from which lard is made consist of the fatty tissues removed from the hog on the killing floor and also the fat trimmings which are cut from the carcass on the cutting floor as the hog is dismembered into the various commercial cuts of pork.

The production of a high-quality lard lies in the rapid chilling of all fatty tissues immediately upon removal from the carcass. A thorough and rapid disintegration of the fat cells, by prompt rendering; then a settling or filtering to remove suspended materials and moisture, followed by another rapid chill over a lard roll, or by some similar method, puts the lard into a solid state. Even then it should be kept under refrigeration until consumed.

The most obvious use of refrigeration in lard manufacture is at the point where the product is chilled into the solid state for packing. There are several ways by which this is done. Grainy lards are those in which the crystals have been allowed to grow during formation. This condition is obtained by running the warm melted lard into the ultimate containers, such as tierces, drums, or cans; placing the containers in chill rooms, and allowing the product to solidify under these conditions. Obviously the size of the crystal is dependent upon the temperature of the lard as it goes into the package and the temperature of the chill room in which the packages are placed. If a large grain is desired, slow chilling conditions are arranged, while if a small crystal is wanted the opposite conditions must prevail.

By far the largest bulk of lard on the market is known to the packer as smooth lard, which means that it has been chilled so rapidly that only exceedingly small crystals can be formed, giving the resulting product a smooth or greasy feeling. This type of lard is obtained by passing the product over the well-known lard roll. The size ordinarily employed consists of a hollow cylinder 4 ft. in diameter and 9 ft. long. The interior is so arranged that brine or liquid ammonia is admitted to the bottom through the shaft and removed from the top through the other axis. A shallow trough running the full length of the roll receives and holds the melted lard against the surface of the cylinder, which picks it up and chills it more or less immediately, depending upon the thickness of the film. This thickness is regulated by a scraper which is set at a definite distance from the surface of the roll and parallel to it. Underneath the trough a series of knives or scrapers press against the roll and peal the chilled lard from its surface, dropping it into another, larger, and deeper trough, which contains a series of small paddles attached to a shaft and revolving at a fairly rapid rate for the purpose of thoroughly mixing the lard, thus delivering a homogeneous chilled mass into the agitator tank. This latter has a heavy agitator, usually containing refrigerating coils or jacket to keep the lard thoroughly mixed and chilled as it is drawn into the final packages.

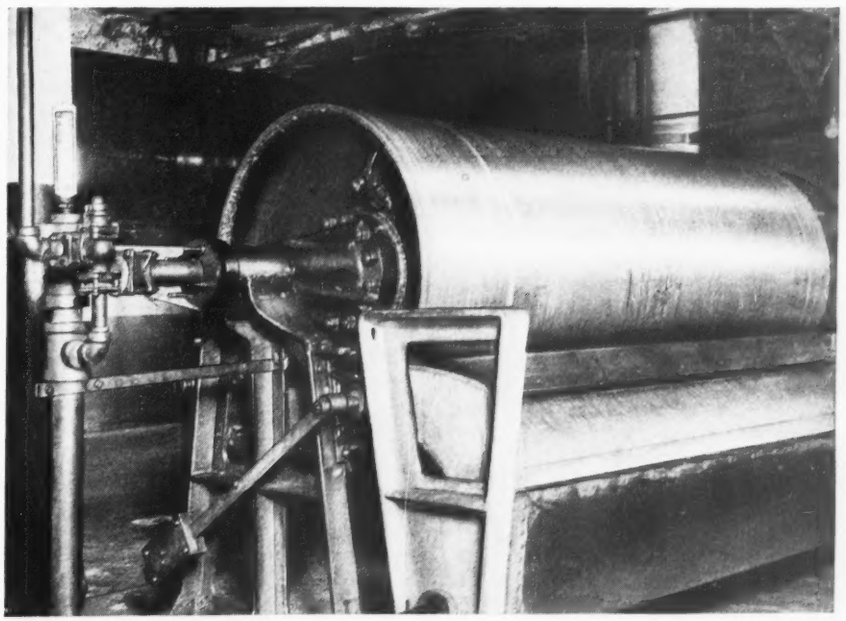
Many refineries, in chilling lard, use two rolls arranged in tandem. The first roll ordinarily is chilled with water, the temperature varying with the season from 58 to 68 deg. F. The lard is run onto this roll after it has been bleached and should not have a temperature to exceed 140 deg. F. As it leaves the first roll the temperature should be reduced to such an extent that it strikes the second, or brine, roll at temperatures ranging from 105 to 110 deg. F. The practice of operating the brine roll varies considerably in different establishments. Where direct expansion —that is, expansion of liquid ammonia directly into the roll—is used, the incoming temperature may be as low as 4 deg. below 0 F., and the outgoing temperature anywhere from 10 to 20 deg. F. Where brine is used as the cooling medium, the incoming temperature varies from 0 to 10 deg. F., and the outgoing temperature from 20 to 30 deg. F. Under ordinary plant conditions the refrigeration required for chilling lard as described is approximately one ton per ton of product.

Texture in lard is extremely important, as it has been found that for pies and pastries a tough lard gives the best results, whereas a softer lard works better in bread and rolls. Experienced operators can regulate conditions so as to get almost any desired texture in the finished lard, provided they have a normal product to start with. Toughness is obtained by exceedingly rapid chilling, which is regulated largely by the thickness of the film on the lard roll. As already explained, this is controlled by an adjustable knife, which is set at distances of $\frac{1}{16}$ to $\frac{3}{16}$ in. from the surface of the roll, depending upon the texture desired.

In many refineries the lard roll is erected in a room that is not refrigerated. Where this is the case, moisture has a tendency to deposit on the surface of the roll previous to its starting up, and great care must be taken to see that this is all removed and that the first running of the lard is put back into a drying tank to remove moisture and prevent this from getting into the finished packages.

Refrigeration in the manufacture of lard is, therefore, extremely important, because it inhibits bacterial and enzymatic deterioration, diminishes oxidation, and produces the desired type of texture in the finished product.

Lard chilling roll showing connection through shaft for refrigerant



Vegetable-Oil Shortening Has Rigid Refrigeration Needs

By G. E. LEAVITT, JR.
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THERE are two types of vegetable-oil shortenings. One is a mixture of vegetable oils with either hydrogenated oil, oleo stearine, or a similar animal fat. At one time this was the only kind. A 100 per cent hydrogenated product, the other type, is now being produced in increasingly large proportions. The application of refrigeration is very similar for the two products, in that they both are essentially mixtures which, on cooling in atmospheric temperatures, separate into clear oil and solid fat crystals.

In order to get a vegetable-oil shortening into a form similar to hog lard, it is necessary to mix the ingredients intimately at a temperature above the melting point of the hydrogenated oil in it and then to chill the product suddenly, so that no large crystals can form. The product is then a stable uniform mixture at ordinary atmospheric temperatures; it has a "body," as we call it, there being no free oil apparent in the mixture. The hydrogenated oil is distributed in the mixture in small crystals in sufficient quantity to hold the oil "in place."

For economy, this chilling usually is done in two steps. First, the hot mixture is cooled part way by passing it (1) through coils submerged in water, or (2) through a heat exchanger, or (3) over a lard-chilling roll through which water is passed as a cooling medium. The chilling should be carried as far as possible in this step in order that the minimum amount of cooling by mechanical refrigeration may be necessary in the second step.

For this initial chilling, the use of the lard-chilling roll is preferable, but it requires the most space. Furthermore, additional power is required for turning the roll and for pumping the product from the roll to the second step in the process. Maintenance, however, is low.

With the submerged coils or heat exchanger, some of the shortening crystallizes and accumulates on the surface of the pipe or tubing through which it passes, cutting down the efficiency and capacity of the apparatus, because the film of shortening is not a good heat conductor. This film has to be removed at the end of a day's work by heating up the pipe or tubing. The maintenance, especially in the case of the submerged coils, is considerably higher than with the roll, due to corrosion of the piping.

The second step in the chilling of the shortening is done on a lard-chilling roll through which cold calcium chloride brine is passed or in which ammonia is expanded directly. These rolls are of various sizes, but usually 4 ft. in diameter and 9 ft. long. The shortening is fed to a trough on the front of the roll, with the roll forming one side of the trough. The roll picks up a film of shortening as it revolves away from the trough. The film is chilled as it travels around with the roll and is removed from the roll by a knife on the under side of the trough.

The capacity of such a roll varies widely with different shortenings. The shortening is chilled sufficiently to give a hard sheet coming off the roll. This sheet is beaten in a picker box located under the feed trough and then conveyed to the suction outlet of the picker box by a picker shaft. The beating mixes air with the shortening and gives a white, smooth semi-fluid product. The temperature of the sheet varies with different shortenings but has to be controlled within definite limits for any given shortening. If it gets too cold or too warm it is difficult or impossible to get the proper smoothness, color, or consistency of the product. If too cold, difficulty may be experienced in pumping it. Temperatures of brine used vary widely with different shortenings and even with the same shortening in different plants. Of course, the rate of flow of brine has a bearing on its temperature also.

In the only plant that has come to my attention where direct expansion of ammonia in the roll was attempted, it was found impossible to control closely enough the temperature of the roll and of the sheet coming off, and the attempt was abandoned. I believe, however, that some concerns use this system.

Each roll and each shortening is a problem in itself. Two standard rolls handling shortening from the same tank and using brine out of the same pipe have been known to operate regularly at capacities in the ratio of 3 to 2. Different all-hydrogenated shortenings vary more between themselves in their requirements as to temperatures and the like than do the older type shortenings, and have to be controlled more closely.

As the important factor in the manufacture of shortening is the brine temperature within the roll, thermometers should be installed on the inlet and outlet of the roll brine lines. The refrigeration engineer can be instructed as to what temperature of brine is desired for the particular formula in use and can maintain this within plus or minus one degree by use of the ordinary controls in the refrigeration plant. No automatic regulation of brine temperatures is necessary. In my experience, attempts to regulate the brine flow in the roll room by means of bypass lines, and the like, to counteract any changes in temperature of brine delivered, have made for worse rather than better regulation. The location of the roll with respect to the refrigeration plant, however, has a bearing in this matter. The flow of brine through the roll should be practically constant but need not be automatically controlled.

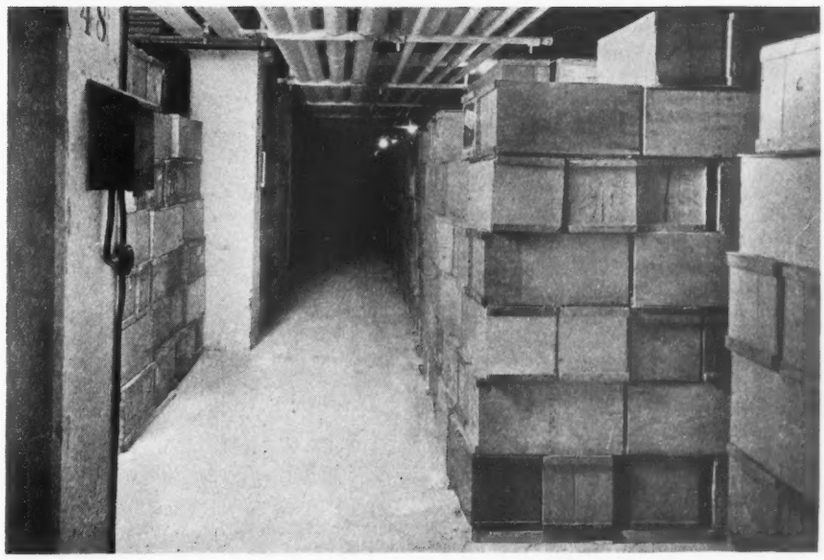
The amount of refrigeration required varies widely with (1) distance between roll and refrigeration plant, (2) kind and condition of insulation on lines, (3) capacity at which each roll is operating, and (4) the average number of rolls operating. If a sufficiently large insulated brine tank is a part of the system, it is well to empty brine out of each roll upon shutting it down, to prevent the formation of a heavy coat of ice on the outside surface of the roll. This coating may damage knives upon starting the roll again if the ice has not had time to melt.

The two annoying features of the roll are the bearings, and stuffing boxes through which brine lines to roll pass. Ordinarily only the bottom half of the roll shaft has a bearing. Because of a combination of faulty design and neglect, it is often not properly lubricated. From time to time the babbitt will be found to have worn away completely. If the stuffing boxes are too loose, they are likely to give trouble from leakage upon starting the roll up. If the packing is too tight, it may seize the pipe passing through it.

In the refrigeration plant proper, it is the rectifier, weak liquor cooler, condenser, and absorber coils that give us our maintenance problems. In my experience, a not too clean salt water combined with a humid and perhaps slightly acid atmosphere make the pipe in these coils waste away all too soon. This is especially so in the case of the rectifier and weak liquor cooler coils, where high temperatures are an additional cause of rapid corrosion. All coils are galvanized extra heavy pipe. An attempt is made to keep paint on the coils as a further protection, it being applied after the galvanizing has aged. Trouble was experienced with the seams of wrought-iron pipe used first, deterioration seemingly concentrating here. Seamless steel pipe was next used, but steel is not nearly the equal of wrought iron against corrosion, and we are going back to wrought iron for another trial.

Refrigeration Stabilizes Egg Supply

By LEO D. OVSON
and
MORRIS OVSON
President, Ovson Egg Company, Chicago, Ill.



Cold-storage room with cases of shell eggs piled to allow air circulation

WHEN spring eggs are placed in storage, the temperature must be held at about 33 deg. F.; however, summer eggs have absorbed more heat by the time they reach cold storage and require a temperature of 29½ deg. F. About one-third ton refrigeration is required to cool 33 cases, 30 doz. each, of shell eggs to 29 deg. F. from an entering temperature of 70 deg. F.

The temperature for shell eggs is maintained between 29 and 31 deg. F. Upon arrival at egg-breaking plants, the shell eggs are taken to a chilling room, where they are kept at a temperature of 31 deg. F. The chill, which is maintained from 12 to 28 hours, stiffens the whites and facilitates the grading and separating processes later on.

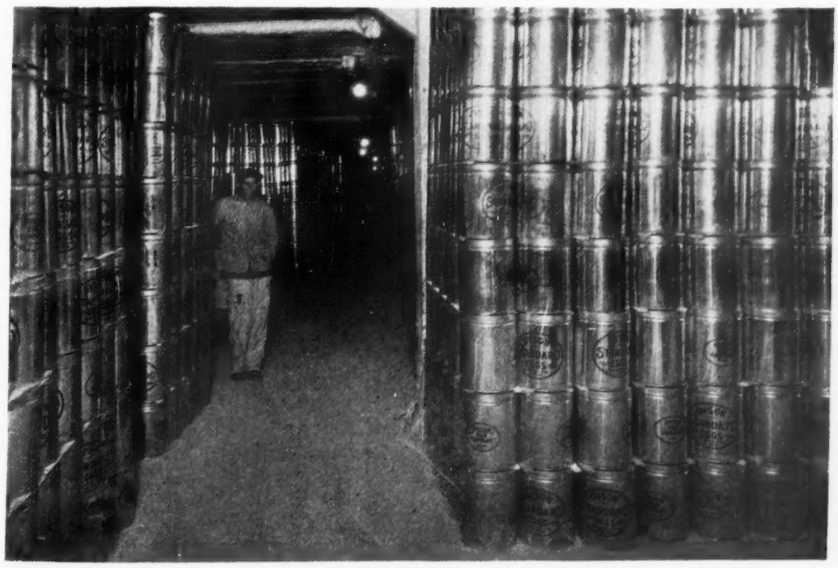
Shell eggs kept at 33 deg. F. show a marked tendency to sweat when transferred to ordinary temperatures, and the shells become very wet and also more brittle. After breaking the shell and keeping it at room temperature for one day, the odor of these storage eggs, while not unpleasant, nevertheless differs from the odor of fresh eggs.

Cooling of the shell eggs aids in the separation of whites and yolks. However, the longer the eggs are kept in cold storage, the more difficult becomes the separating process. Keeping eggs too long in storage invariably results in contamination of the yolks by the whites and impedes their separation.

When fresh eggs are boiled, a loss in wheight occurs, while storage eggs gain on boiling. Apparently the whites lose more water than do the yolks, and, consequently, gain more when boiled. The boiled yolks when fresh contain about 50 per cent of water, while cold-storaged boiled yolks contain about 64 per cent of water.

Cold storage produces other changes in the composition of the eggs. Eggs in storage for one year show a loss of weight equivalent to 10 per cent of the total weight, which is largely made up of water from the whites. Eggs which are kept in storage for more than a year lose their power of cohesion and emit a characteristic odor after opening.

Cans of frozen eggs held at 0 to —5 deg. F.



When shell eggs are kept at too low a temperature range, the contents of the egg freeze, expansion of the contents within the shell occurs, and the pressure within the shell becomes so great as to cause the shell to burst and disrupt. If the contents of a shell egg are once allowed to freeze, the egg becomes unfit for consumption.

When shell eggs are kept at too high a temperature range, the egg will soon deteriorate and spoil. The warmer the temperature in which the eggs are kept, the more readily does the contents deteriorate and assume putrid odors. A shell egg kept at a high temperature is more subject to the entrance of molds, bacteria, and enzymes—the three agents of deterioration—through the pores of its shell than is a similar shell egg kept at proper refrigeration.

Broken eggs in 30-lb. cans are frozen solidly in 48 to 60 hours at temperatures of approximately —5 to —12 deg. F. and are kept at from 0 to —5 deg. F. Approximately one ton refrigeration is required to cool a ton of canned eggs from 70 deg. F. to —10 deg. F. in 24 hours.

If frozen eggs are kept in cold storage under too low a temperature range, the frozen egg contents expand and exert a great pressure upon the cans. When the pressure becomes too great, the cans bulge and the bottoms of the cans are forced out. In many instances, too low temperature causes the egg contents to freeze too rapidly and may create a chemical change in the composition of the eggs.

If frozen eggs are kept in storage at too high a temperature range, the egg contents will freeze too slowly, causing loss of strength and consistency.

To obtain the best results from eggs, they must be kept under proper refrigeration. The best temperature range for shell eggs is from 29 to 31 deg. F., and for frozen canned eggs from 0 to —5 deg. F.

Refrigeration in the Milk Industry

By J. P. KIRKUP

Borden's Farm Products Company, Inc., New York City

MILK, like many other foods, will keep longer and taste better if it is kept cold. Health regulations usually require that milk, other than certified, must be pasteurized. This is accomplished in various ways. New York City regulations provide for quick heating to 143 deg. F., holding for 30 minutes, and then quick cooling. Except during the pasteurizing process, the milk must never be above 50 deg. F., and 40 deg. F. is better.

When drawn from the cow the temperature of milk is approximately 90 deg. F. In the Northern states it is customary for the dairyman to cool it at once below 60 deg. F., thus greatly retarding bacterial growth. Occasionally artificial refrigeration is used to supplement water as a cooling medium—natural ice is frequently used.

When delivered to the receiving station of the milk company, such milk as is not processed immediately is cooled to a lower temperature, preferably below 40 deg. F., and held in large tanks until needed. At this temperature bacterial growth is very slow. In the Southern states, where cooling facilities on the farms are necessarily inadequate, the milk must be delivered to the receiving station twice each day (immediately after milking). This obviously increases the cooling which must be done at the receiving station, and as practically all of the cooling is done by mechanical refrigeration, the refrigerating equipment must be much larger than in the North.

If the milk is to be pasteurized and bottled, the pasteurized milk is cooled as low as possible with water and then cooled by refrigeration to about 40 deg. F. before going to the bottle fillers. The filled bottles are then put in cases and placed in chill rooms which are kept cool by refrigerating coils, frequently supplemented by crushed ice placed on the cases of bottled milk. This ice serves also to keep the milk cool while being carried in the route wagons. When the weather is warm and the cases of milk are carried by truck or train for delivery to the depot from which the route wagons start, the quantity of ice used will be much greater than when the route wagons start from the plant at which the milk is bottled.

When the fluid milk is used for making condensed milk or evaporated milk, the refrigerating requirements are not so severe, as the use of ice can be avoided. The concentrated product as it comes from the vacuum pan is at a temperature of about 125 deg. F., but it is cooled as low as possible with water before refrigeration is used. Between the time of filling the condensed or evaporated milk into cans and its delivery to the consumer it should be held at a reasonably low temperature. When refrigeration is used, the storage rooms are held at about 46 deg. F.

Due to varying conditions, it is impossible to state even approximately the amount of refrigeration required in a milk plant. An evaporated-milk plant in the Northern states or Canada having an abundance of cold water could operate very comfortably with one-tenth the refrigerating machine capacity required by similar plants in many parts of the South where both weather and water are hot. Indeed a Northern plant located where the dairymen as well as the plant have plenty of cold water could operate more comfortably without refrigeration than a Southern plant with ample refrigeration but without cooling facilities on its farms. Rapid cooling to 60 deg. F. is more valuable than a gradual cooling to a lower temperature.

Rapidity of cooling is valuable in plant operation as well as on the farm and both coolers and refrigerating machines should be large enough to do the work promptly. At or above pasteurizing temperatures, most harmful bacteria are destroyed but some change takes place in the physical characteristics, so high temperatures should not be held longer than necessary. If, however, cooling takes place slowly and the milk is held at temperatures between 110 deg. and 80 deg. for a considerable time, the bacteria will grow very rapidly.

Because of its convenience, brine generally is used to cool the milk below temperatures obtainable with the water supply available and brine coils are frequently used to cool the chill rooms. When ice is manufactured, brine from the ice tank may be used for all three purposes. The brine is cooled by ammonia coils.

Ammonia sometimes is used in a special type of milk cooler and is frequently used to cool the chill rooms. When no brine is used, it is essential to have the ammonia compressor of ample size, as no refrigeration can be stored to take care of peak loads, as can be done with brine if the brine tank is large.

To operate ammonia compressors, a supply of water to condense the gas back to a liquid is necessary—the colder the better, as the condensing pressure is lower when the water is cold. When the natural supply of water is warm, spray ponds or cooling towers may be installed to cool the water before it is used for condensing the ammonia gas.

As previously stated, no information regarding the amount of refrigeration can be given until the conditions at the plant are known, but the *rapid cooling* of milk is so important that careful thought should be given to this problem as soon as sufficient data are available.

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Refrigeration in the Curing of Meat

By C. ROBERT MOULTON

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THE curing of meat by means of salt and other recognized ingredients is one of the chief methods of making meat keep and so having it available at seasons or times more or less remote from the time of delivery of the meat-producing animal to the packing plant. Salt, sugar, sodium nitrate, and sodium nitrite are the ingredients used in American practice. In the concentrations used the sugar adds little to the keeping qualities of the product. Salt is the chief curing agent, but there is ample experience both in practice and in research to show that the nitrate and nitrite have some function to perform aside from color fixation.

In the process of producing successfully cured meat that will keep well, refrigeration plays a most important part. Between the time of production of the freshly killed carcass and the turning out of the finished cured meat, refrigeration is often the sole, and always an important, defense against the inroads of spoilage.

After slaughter, carcasses of meat-producing animals should be chilled as quickly as possible to an internal temperature of about 34-36 deg. F., and the meat should subsequently be held as near that temperature as possible until it has been placed in the curing vats. While 48 hours of chilling was once standard practice, 24, or even 18 hours, now suffices to do the same job.

In the rapid chilling of the carcass a good circulation of air must be maintained. This air is chilled to a low temperature by being passed through a fine, cold brine spray. The chill room and brine spray lofts must be so designed that there is a proper circulation of air and that no dead air spaces or pockets occur. When they do occur

there will be slow chilling of some carcasses, with a later tendency to the development of "sour" hams or partly spoiled meat during the cure.

The matter of temperature control in the chill room is important. The ideal is prompt and even reduction in temperature of all carcasses in the chill room. In practice this is often not attained. Differences in internal temperature of the meats in different parts of the same room at one time may easily be as much as 4 deg. F. or more. These differences are significant and should be eliminated as much as possible. Proper design, loading, and operation of the chill room will accomplish this end.

During the cutting up of the chilled carcass and the trimming of the cuts to be cured, the meat should not be allowed to become warm. The temperature of the cutting floor should be held at about 45 deg. F. and the meats should be sent promptly along into cure. If carcasses are too cold during cutting operations they can be cut up only with difficulty. On the other hand, if the temperature is too high, spoilage is encouraged. Of course, this spoilage is detected only after cure has progressed for a considerable portion of its allotted span of time. Therefore, the curing foreman may receive unmerited blame.

The cuts from the carcass are placed in brine chilled to a temperature of 38 deg. F. and held in a room at the same temperature. A uniform temperature of 38 deg. F. throughout the room is maintained by a circulation of cold air produced by passing the air over coils in which ammonia is expanded directly and over which brine is circulated. Variations of only 2 deg. F. from the temperature of 38 deg. are very significant and should be avoided. A reduction in temperature retards the cure of the meat, curing at 30 deg. F. taking more than twice as long as when carried out at 38 deg. F. An increase in temperature permits the forces of spoilage to overcome the defenses of the curing agents, with a resulting increase of more or less spoiled meat.

The amount of refrigeration required varies with the function being performed. For chill rooms, 80 B.t.u. of refrigeration is required per cubic foot of chilling room capacity per 24 hours. In the curing cellar, but 40 B.t.u. is required per cubic foot capacity per 24 hours.

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Chilling Meat in Packing Plants

By DONALD MACKENZIE
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Chicago, Ill.

PROPER refrigeration of meats has been a problem that has engaged the attention of the meat packer since the earliest days of the industry. Less than a century ago practically all of the slaughter of meat animals was done during the winter months. Meat which was eaten in the summer was largely cured product, and it was a strongly cured product at that.

The meat packer's combat to keep meat fresh and wholesome is a never-ending battle, requiring his ceaseless care and attention. His best weapons are cleanliness and reduced temperatures. This struggle is a peculiar one, as the packer must win every scuffle and every encounter, because if he does not, his product is not suitable for food and must be destroyed. It is evident, therefore, that as soon as the animal leaves the killing floor, it must be refrigerated promptly, and from that time on kept at a proper temperature until delivery to the consumer.

The application of refrigeration at each step in the process calls forth a variety of methods, each of which is adapted for its particular purpose. Without question the most important refrigerating operation is the chilling of the meat after it leaves the killing floor. The blood temperature of such animals as cattle and swine is about 100½ and 103 deg. F., respectively. As soon as the animal has been dispatched, the flesh must be guarded to avoid deterioration from bacteria, because its temperature is close to the optimum for their growth and because there is available a very adequate supply of food.

The packer, therefore, conducts the dressing operation in the most sanitary and cleanly fashion, and as soon as possible after the dressing conveys the animal into a room of low temperature, so that the meat can be chilled to the point which inhibits bacterial growth.

There is an interesting historical background to the evolution of the present meat-chilling room. So important is refrigeration for the chilling of meats that in the early days of the industry killing was practically limited to the winter season, the meat being chilled in a cooler refrigerated by outside winter air. The shipment east was precarious because the product was shipped in an ordinary box car and the meat was liable to be frozen in Indiana, thawed in Ohio, and perhaps frozen again before unloading in New England.

Coolers were originally built which held huge quantities of ice and salt in overhead bunkers. One could well imagine the period of mental and financial anguish that a meat packer of those days experienced when he had the beef cooler filled to capacity during the midst of an extended hot spell. The failure of an ice crop in about 1880 brought about the rapid development of mechanical refrigeration in the packing industry. Since that time coolers have been and are being developed to fit many different conditions and various styles of construction.

When natural ice was used for refrigerating purposes, these coolers were equipped with overhead bunkers which had to be made especially strong, with pans, drips, and other methods to avoid leakage on the product below and to prevent the rapid wood decay which accompanies water soaking. These early coolers were constructed to take advantage of the physical phenomena that hot air rises and cold air falls. A duct was provided on one side of the bunker, into which the warm air from the cooler flowed. As the warm air intermingled with the ice in the bunker, it was reduced in temperature and descended through the cool air duct on the opposite side of the bunker to replace the air that previously arose upon heating; thus continuous circulation was created.

When the use of natural ice was discontinued, coils through which cold brine circulated were substituted in the same style room and the design continued pretty much unchanged for some time. However, it soon became evident that the chilling time could be reduced by increasing the height between the animal and the ceiling, by decreasing the resistance to the air flow, and by the use of brine sprays.

The spray-cooled cooler creates a forced circulation which speeds up the chilling effect. This forced circulation is caused by the mechanical action of the brine, which forces the air toward the cold side of the bunker, and it is also aided by the cooling effect of the brine.

Another variation of this type of cooler is the direct-expansion type. Here the bunker is piped with direct-expansion ammonia coils over which spray nozzles force defrosting brine. These spray nozzles, in addition to preventing frost on the coils, aid in creating a forced circulation.

In the case of swine, the speed of chilling is one of the most important considerations. Therefore, most hog coolers today are equipped with some type of spray system. Quite a few years ago there existed in the industry a fetish which dictated that before the pork carcasses could be hung in the cooler, it was necessary that they be allowed to remain in an unrefrigerated hanging room for the purpose of preliminary and slower cooling. It was

said that the purpose of this preliminary room was to allow the "animal heat" to dissipate before being locked in the carcass by the subsequent chilling. It was further reported that if the animal heat was locked up, it would cause spoilage of meat in the curing pickle. Just what prompted this line of reasoning is difficult at this time to analyze.

Whatever the methods in the past with reference to chilling meat animals, today the modern meat packing plant expedites the handling of meat to and through the cutting rooms as rapidly as possible. Economy of time is essential in order to assure both retail dealer and consumer a wholesome and appetizing product.

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Refrigeration in Cereal Beverage Plants

By F. W. RABE and R. W. BUSSEN
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WHEN we speak of the manufacturing and production of cereal beverages, refrigeration gains almost immediate attention, since it is one of the major items essential in modern brewing practice. Most converted breweries or cereal beverage plants do not always employ the most modern refrigerating systems and this paper will describe in only a brief manner the general refrigerating practice as found in plants of this nature.

By cereal beverages is meant those carbonated drinks produced from cereals and malts, such as rice, barley, barley malt, and the like, that are produced from alcoholic beers fermented in the usual way. Refrigeration as applied and used in these processes may be classified as "refrigeration used for process" and "refrigeration used during storage of the finished product." The general practice of applying refrigeration in the manufacture of these products has changed very little during the last twenty years. Practically the same type of equipment and the same methods are used now as then.

A liquid extract known as wort is produced in the brewhouse and from there discharged to the beer cellar at almost boiling temperature—190 to 200 deg. F. The wort is then cooled to about 45 deg. F. by passing it over a cooler, commonly known in the brewing industry as the Baudelot cooler. This cooler consists of a series of horizontal coils arranged somewhat on the order of the pipes in an atmospheric type ammonia condenser. Through the upper portion of this cooler water is circulated, and ammonia or brine flows through the lower coils. The wort to be cooled cascades over the cooler-coils and is caught in a suitable basin below the cooler. It is customary to install these coolers in a well-aërated room in order to gain the slight refrigerating effect caused by evaporation. Contingent upon the temperature and quantity of cooling water available, the temperature depression of the wort in passing over the water-cooled coils ordinarily is from 100 to 130 deg. F. On the basis of 6 sq.ft. of cooling surface of cooler per barrel of wort per hour of cooling time, it has been found that tap water, with a temperature of 60 to 65 deg. F. will cool the wort to from 70 to 75 deg. before it passes over the ammonia-cooled coils. With a sufficient quantity of relatively cold tap water available the quantity of ammonia or brine refrigeration required to cool the wort to the desired temperature may be very little. During the summer months this condition is reversed and the rate of artificial refrigeration required sometimes is extremely high, especially if the cooling time is limited.

Approximately 1 ton of refrigeration is required to cool 100 bbl. of wort 10 deg. F. On this basis 3 tons of ammonia or brine refrigeration is generally considered necessary to cool 100 bbl. of wort. During extreme summer conditions as much as 4 tons may be required, with the understanding, of course, that sufficient tap water at 75 deg. F. or thereabouts is available for precooling.

Vertical Coolers Better Than Horizontal

Recently it has been demonstrated that a much higher rate of heat transmission can be obtained if the cooling coils are arranged vertically rather than horizontally. This is due to the fact that the liquid to be cooled has better contact with and a higher velocity over the cooling elements. Tests have shown that the rate of heat transfer is nearly twice as great in a cooler with vertical coils than one with horizontal cooling tubes.

From the beer cellar the wort passes to the fermenting cellar, where additional refrigeration is required to remove the "heat of formation" produced during the generation of alcohol caused by the fermentation of maltose sugar. As previously indicated, the initial temperature of the wort undergoing fermentation is about 45 deg. F. As fermentation activities commence a temperature rise occurs, due to the heat of formation of alcohol, which is 70,000 gram calories per gram molecular weight. To retard the fermentation activity refrigeration is necessary. Brine cooling usually is resorted to. Refrigeration at this point also protects against excessive temperatures during the fermenting process, thereby resisting foreign fermentation activities, such as lactic acid and the like.

It is found in practice that approximately 35 to 45 tons of refrigeration is required during the fermentation period for every thousand barrels of beer fermented. After fermentation, the fermented wort or beer is allowed to remain in storage, during which time it ages and matures. This period is at least 3 months. After this process is completed, the beer, which contains about 4 per cent of alcohol by volume, is de-alcoholized.

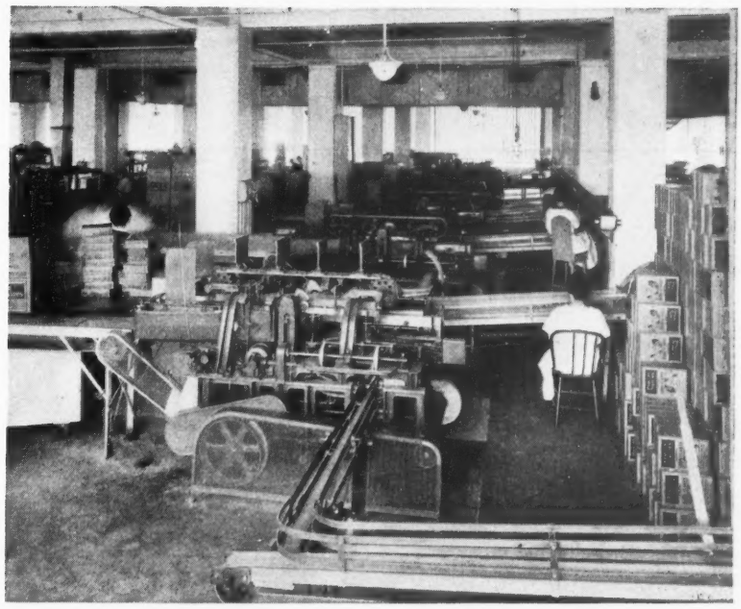
De-alcoholizing Beer

During the de-alcoholization process, which is one of evaporation under vacuum, approximately 40 per cent of the volume of beer is evaporated. The distillate contains the alcohol, which is later removed by further distillation. The de-alcoholized beer, after passing through a heat exchanger, is further cooled—ordinarily by passing it through a double pipe brine cooler—before it is further processed to produce the finished beverage.

Experience indicates that for every thousand barrels of beer de-alcoholized, 10 to 12 tons of refrigeration is necessary. In the processing of the de-alcoholized beverage at least 3 to 5 tons of refrigeration is necessary to absorb the heat of formation during the "check" fermentation process. During this process, as in the fermenting cellar process, the refrigeration usually is supplied through the medium of brine. The maximum total refrigeration necessary per thousand barrels of finished beverage is, on the basis of the foregoing, estimated at 90 tons. In certain plants 100 tons or more is estimated as the maximum refrigeration required per thousand barrels of the finished beverage, and this figure usually includes the refrigeration for maintaining the beverage cool prior to bottling.

In the cereal beverage industry it is essential that correct temperatures of the liquid be maintained during the various stages of its processing. The room temperatures in the cellars vary and may be anywhere between 33 and 44 deg. F. Complete loss of refrigeration during warm weather would not only stop production but might result in partial spoilage of the beverage in process.

Air Conditioning And Refrigeration



Prepared cereals are packed and sealed in this room, which is supplied with conditioned air from the duct in the rear to provide a cool, non-humid atmosphere to assure desirable crispness

By D. C. LINDSAY
and
A. E. BEITZELL
Engineers on the staff of
Carrier Engineering Corporation
New York City

AIR is not only the carrier of life-giving oxygen but the medium by which heat is transferred to or away from our bodies and materials with which we have to deal. It is also frequently the carrier of foreign matter—dust, dirt, bacteria, moisture in the form of water, vapor, and other gases foreign to the pure mixture which we call air.

So, we have the simple conception of air as the dominating medium which, if we control its conditions, its temperature, its humidity, its cleanliness, its rate of movement, we can adapt to the useful purposes of cooling, of heating, of drying, of moistening, and thus control the many chemical and physical reactions of the materials with which we have to deal in our whole system of living.

Air is the medium through which we withdraw heat from foods and other materials and transfer it to blocks of ice or to pipe coils through which a cold expanding fluid is being passed.

Air is employed to convey heat to materials and to carry evaporated moisture away in controlled processing and dehydration. By the control of atmospheric temperature and humidity, we can hasten or retard, at will, the ripening of bananas and other fruits in transit or storage.

The control of yeast fermentation and mold formation by conditioned air offers intriguing possibilities for foods in which this activity plays an important part. In the bakery, the rate of fermentation and the proofing of the dough are influenced directly by the condition of the surrounding air. Controlled air conditions fix definite schedules and determine very largely the final condition and quality of the bread. Confectionery manufacturers in Los Angeles, Atlanta, Boston, and Halifax can operate every day of the year with exactly the same conditions in their respective plants. Controlled conditions of temperature and humidity contribute to the production of high-quality confections, and allow a uniform number of well-trained employees to work on definite production schedules and to store goods against rush-season demands. Many products require lower-than-normal temperatures, yet are destroyed by temperatures approaching those of freezing. Others require accurate humidity control to prevent the loss of moisture or the possibility of bacterial activity. Still others require careful control of air velocities or thorough sanitation.

An example of the control of several of these factors is afforded by the experience of a large distributor of bananas which we previously cited. Under ordinary cold storage, the ripening period was slow and uncertain. At the higher temperatures necessary for this process, loss of weight occurred through skin evaporation, and the shrunken, mottled appearance of the product forced its disposal at the lowest prevailing price. After installing conditioning equipment, the loss of weight was reduced from over 10 to less than 1 per cent, a saving of approximately 200 lb. per ton of bananas. In addition, the time of ripening was placed on a definitely known schedule, advantage could be taken of any quick rise in the market, and the improved quality and appearance of the product created a decided sales advantage.

In contrast to storage problems, the ability of air conditioning to create and maintain favorable climatic environment has, in at least one instance, led to the artificial propagation of a stable food product, the mushroom. Mushrooms are an exceedingly delicate plant, reacting instantly and usually unfavorably to small variations in temperature and humidity. While they may be more or less successfully propagated without air conditioning, the control afforded, the more rapid crop rotation, and the elimination of many of the vicissitudes that make mushroom growing a hazardous financial undertaking more than compensate for the comparatively small investment required for an air-conditioning system. A number of mushroom growers have turned to air conditioning for a solution of their many difficulties. The results have been favorable in the extreme, for not only has the product been greatly improved in appearance and flavor but the growers have been able to produce mushrooms during all seasons of the year, rotating crops as often as every two months.

Elimination of the human element and complete mechanization of a typical farm product was never more clearly exemplified than in the dairy industry. As a final refinement, we have the introduction of the "Rotolactor," a huge revolving turntable, on which fifty cows are washed, dried, and machine-milked every 12½ minutes. To keep flies, bacteria-laden dust, and other contamination out of the milking room, all windows must be kept closed. But with the heat given off by the cows, the

Packing chocolates in one of the air-conditioned departments of the Schrafft factory. Conditions, 65 deg. F., and relative humidity, 50 per cent

sterilizing and drying apparatus, the result would be undesirable milking conditions for the cows, the men attending them, and danger of bacterial growth in warm, favorable conditions. With air conditioning, the only air entering the room is that supplied by the system itself. This is cleansed, cooled, and circulated to all portions of the milking barn. Since the milk yield decreases during humid summer months, there is a possibility that ultimately the cow barn itself will be conditioned.

A great many salts, dried and powdered products, breakfast foods, and similar products are extremely hygroscopic. Such materials when exposed to high humidities greedily absorb moisture from the air, oftentimes preventing further processing or packaging operations. An example of how this property of a material may seriously disorganize a production schedule is afforded by the experience of a manufacturer of a packaged, shredded fish. Here the product was received in a salted condition and hung on racks before being further processed. During especially humid days, the salted fish readily absorbed moisture, turning a normally dry product into a soggy, damp mass which could not be shredded. On such an occasion there was no recourse except to suspend operations. Since installing air conditioning, the manufacturer has experienced no further difficulties from this source, production has been put on a definite schedule, and he is enabled to produce a better, more uniform product at considerably less cost.

Another manufacturer, producing a powdered infant food, estimated that the savings due to the elimination of "off days" alone amounted to more than $600 a day during the summer months, an annual saving far in excess of the cost of owning and operating the equipment.

Besides maintaining products of this nature in a thoroughly dry condition, the maintenance of an even humidity often speeds the packaging operation itself. This is because practically every wrapper, whether paper, foil, or transparent cellulose, usually is as hygroscopic as the packaged material itself, and consequently changes dimension with variations in relative humidity. This, in turn, necessitates machine adjustment or reduction of speed. In one instance, where a cereal was packaged, the manufacturer was enabled to increase his packaging production by more than 10 per cent, eliminating the necessity of purchasing additional packaging machinery.

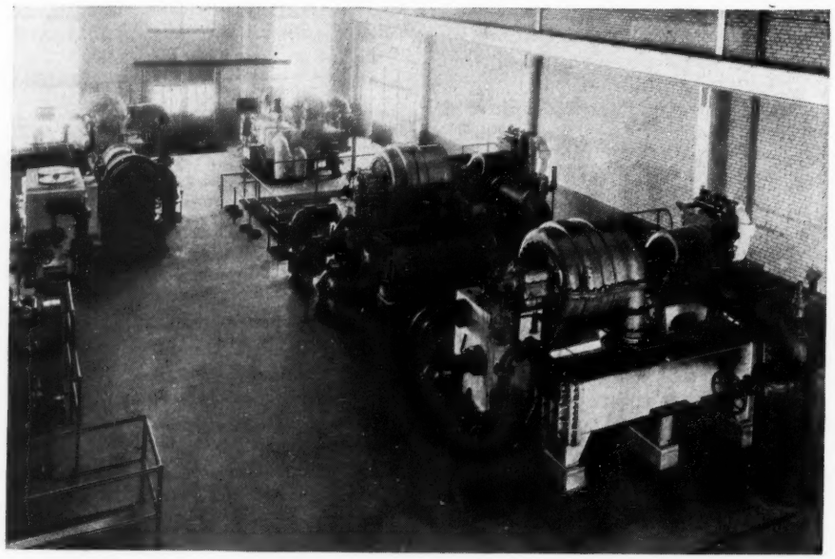
In a plant producing iced cakes, air conditioning is used to hold the biscuits in a firm, dry condition. After the marshmallow has been deposited and allowed to set, the cakes travel on a conveyor through the enrober, where the chocolate coating is applied. Conditioned air supplied to the enrober quickly sets the chocolate, giving the cakes a bright, smooth appearance. Since the cakes emerge into the packaging room at a temperature of around 60 deg. F., it is essential that the dew point of the air in this room be held at a lower temperature to prevent condensation on the cakes. This is accomplished by dehumidifying the air supplied to the whole room and maintaining a cool, dry atmosphere at all times.

Condensation of this sort will always occur where the temperature of the product is below that of the dew point of the atmosphere. Since dew points as high as 65 deg. F. are not uncommon in most localities during the summer months, it is readily seen that this phenomenon always will cause trouble when moisture has a deleterious effect upon the cooled product.

In a large sugar warehouse, it was customary to store the product during the winter months and dispose of it during the summer. Since the warehouse was unheated, the large mass of sugar (over 12,000,000 lb.), once cooled down to winter conditions, did not readily change temperature due to its large heat capacity. Consequently, during the spring when temperatures suddenly increased, with a corresponding rise in atmospheric moisture, condensation occurred on the cold mass of sugar, causing caking of the product. A certain portion of sugar had to be disposed of at a loss. An air-conditioning system was installed to guard against these seasonal and daily variations, through the control of temperature and humidity, within the building. It is well to point out here that a heating system would not only have driven off a considerable quantity of moisture during the winter, causing a loss of weight, but would have been equally useless in the summer to prevent undue absorption because of the prevailing high summer humidities.

These are just a few of the many examples wherein the arts of refrigeration and air conditioning have played important rôles in the food industries.

Centrifugal refrigeration units used in conjunction with the air-conditioning systems and for low-temperature storage in confectionery plant of W. F. Schrafft & Sons Corporation



Favorable Conditions of Temperature and Humidity Artificially Created and Maintained in Various Food Manufacturing Processes and Storage

(This table is offered only to demonstrate the wide variance of conditions which may be demanded even within a single plant.

	Temperature, Deg. F.	Relative Humidity, Per Cent
Bakeries		
Dough rooms	80	80
Proof box	90 to 95	80 to 90
Bread cooling	70	65
Prepared Powdered Beverages and Crisp Cereals	75	35 to 40
Chewing Gum		
Rolling and scoring chicle	75	50
Wrapping and packing	70	45
Confectionery		
Enrobing and hand dipping	60 to 65	55
Hard candy manufacturing	70	40
Starch room	75 to 85	50
Packing	65	50
Dairy Products		
Butter manufacturing	60	60
Chill room	40	60
Fruits		
Apple storage	31 to 34	80 to 85
Avocado packing	40	50
Bananas		
Holding ripe fruit	56	70 to 75
Holding green fruit	58	70 to 75
Slow ripening	60 to 62	90
Normal ripening	64 to 68	90
Fast ripening	70 to 72	90
Danger of chilling	Below 49	..
Meat Products		
Butter substitutes		
Churn room	70	60
Print room	60	60
Chill room	30	60
Cooler	55	60
Bacon slicing	60	48
Egg candling	60	48
Sugar Storage	80	35

The familiar compression refrigeration machines which are widely used as adjuncts to air-conditioning systems have been vastly improved in safety and in efficiency. Hundreds of new sizes have been developed, reaching down from those capable of producing cold in the equivalent of 400 tons of melting ice every 24 hours to the tiny units of $\frac{1}{10}$-ton capacity for the domestic ice box.

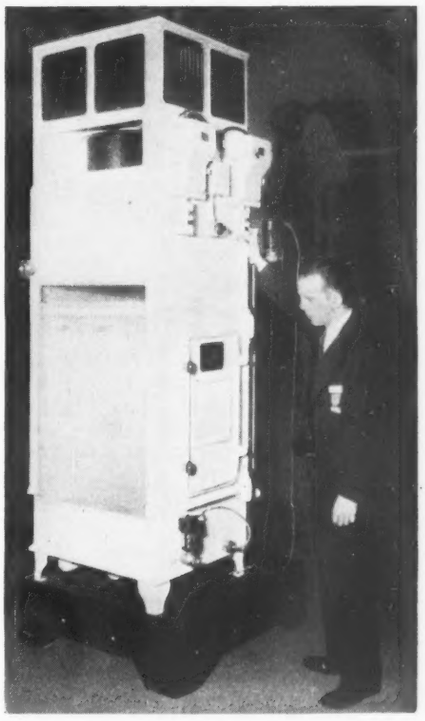
Entirely new refrigerants have been discovered. New mechanical refrigeration systems have been developed. Among these is the centrifugal refrigeration machine operating at pressures below that of the atmosphere, using a simple non-inflammable liquid, dichloromethane ($C H_2 Cl_2$), capable of being driven by a direct-connected steam turbine or motor. This unit is used very extensively in conjunction with air-conditioning equipment and even for the low temperatures required in the storage of materials.

Another interesting new development which is being adapted to air-conditioning uses is the rotary-gear positive compression machine using methyl chloride ($C H_3 Cl$) as the refrigerant.

Constant research has led to vast improvements in the absorption and adsorption types of refrigeration systems. New developments in such equipment promise qualities of compactness, safety, and control, opening up entirely new fields of application in transportation, storage, and air conditioning. Fully refrigerated and air-conditioned produce trains carrying their refrigeration machine in a single car are a likely development of the future.

In storage rooms a new method has been introduced for cooling and distributing air over the products. This is the unit cooler, a system of refrigeration employing ductlessly distributed cold air. These units are especially designed to replace existing side-wall or ceiling brine-coil systems which depend for their successful operation upon the equalization of room temperatures by natural-gravity air circulation.

In such units the cooling surface is compacted within a single casing in conjunction with a motor driven fan, which distributes the air uniformly through all portions of the room, producing quick cooling and responding sensitively to automatic control. Valuable space is saved, sanitation is improved, and added to this are marked economies in the refrigeration power.



Unit air conditioners have placed complete air conditioning within the reach of the smallest factory or manufacturing department

Air-conditioning systems for controlling temperature, humidity, air cleanliness, and air motion in storage, in processing, and in the manufacturing departments are constantly being improved, standardized, and adapted to new uses.

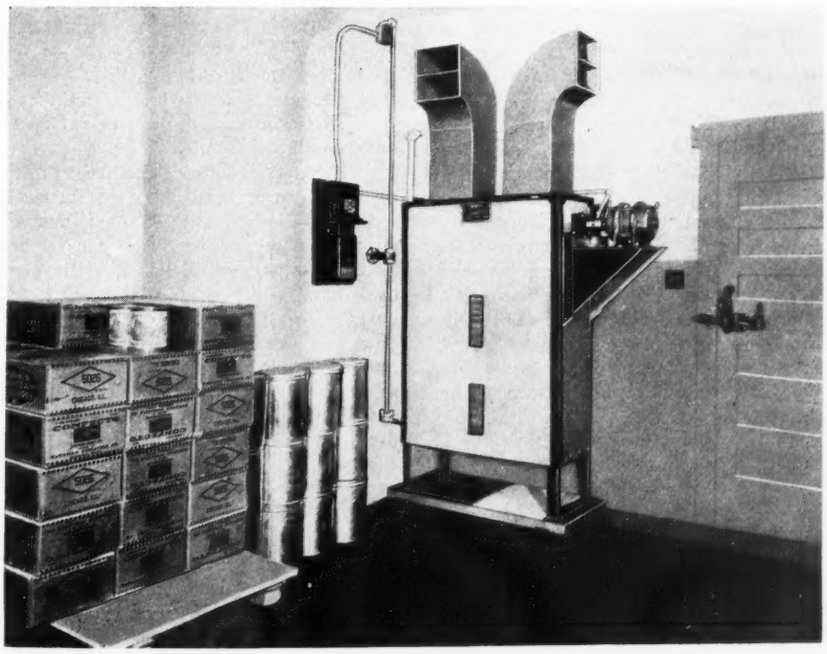
The development of the unit air conditioner, small systems accomplishing all of the results that are produced by the large central station systems in large factories, has made air conditioning available to the small factory, to the individual department, and to the manufacturer in rented quarters.

This is a simple unit which may be placed directly in the department to be conditioned and requires only simple steam, water, and electrical connections.

We have not meant to imply in this brief review of some air-conditioning applications in the food industries that all plants handling weather-sensitive products are so equipped. As a matter of fact, there are many fine plants struggling along in constant combat with the weather, but more and more of these are turning to the air-conditioning and refrigeration engineers to aid them in meeting these problems and in coming up to the new standards that are being demanded.

Unfortunately, it is still true that the food industries have yet to take advantage of many of the improvements in their production which are offered through air conditioning.

This cold diffuser compacts the cooling surface for a storage room in a single casing and mechanically circulates the cooled air throughout the room



Refrigeration Increases Salability of Coated Foods

By JAMES F. CYPHERS
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Runkel Brothers, Inc.
New York City

THE simplest way in which to use refrigeration in the manufacture of coated foods is to put some direct-expansion coils along the walls of the room in which the confectionery or bakery products are made. This room is made to serve all the purposes for which refrigeration is used in the industry, including cooling candy centers, providing the proper room temperature for dipping or coating the centers with chocolate, freezing or drying the chocolate, and providing a cool temperature in which to store the finished product. This arrangement, of course, permits manufacturing to be carried on for most of the year, but trouble is certain to be encountered on very warm or humid days. Each operation is carried out under conditions which are influenced by the requirements of the other operations, so that none is under the conditions for best results.

Often an insulated closet or small room within, or adjacent to, the room used for making the goods to be coated is fitted with direct-expansion coils for the purpose of freezing or drying on trays placed in this inclosed space. The wise manufacturer will also install a small motor-driven fan and arrange for a circulation of air over the direct-expansion coils and around the trays. This arrangement is comparatively inexpensive to install and operate, and is fairly efficient from a production standpoint until the volume of business warrants the introduction of the continuous system with its means of adjustment and control to provide for a large volume and variety of work.

As is well known, chocolate shrinks when it freezes. If the centers are too cold when coated, the chocolate is likely to crack when it freezes, and if too warm, the chocolate on the outside will freeze while the chocolate next to the center stays molten. These conditions are particularly likely to cause discolored chocolate, loss of gloss, or bloom in a short time, depending on how high the temperature of the centers was and their weight and specific heat, compared with that of the chocolate. For best results the centers should be coated when they are just slightly cooler—one to five degrees—than the dipping temperature of the chocolate. This means, as a rule, that the centers must be tempered in a properly refrigerated room for several hours before they are coated or heavily decorated.

The dipping temperature may vary all the way from 80 deg. F. for some milk chocolate coatings and chocolate liquors to be hand-dipped, to 94 deg. F. for high-grade dark chocolate coatings to be used on an enrober. The average dipping temperature for most coatings is one or two degrees above or below 88 deg. F. The reducing of chocolate from melting temperature of not less than 100 deg. F. or more than 115 deg. F. to its dipping temperature, generally called tempering, is carried on as a rule in jacketed kettles with scraper agitators to free the cooling surface from its coating of chocolate. Cold water is circulated through the jacket of the kettle, and where an ample supply of cold water is not available, water cooled over refrigerating coils often is used for this purpose.

The chocolate must be maintained at its dipping temperature until used. If it is used at too high a temperature, it will freeze, with streaks, or even be discolored, and the gloss, so desired by all manufacturers, will fail to materialize; and bloom is certain to appear in a short time. Should the chocolate be used at too low a temperature, it will appear rough and lumpy, is likely to crack, and will have a poor gloss, if any. The best temperature to use can be determined only after careful observation of the work over the limited temperature range within which experience has shown the proper temperature should be. The room in which the hand dipping takes place should be dry and have a temperature of about 65 deg. F. for best results. To meet this requirement, refrigeration generally is necessary.

The next step in the continuous system is to place the goods on a belt which will carry them through a refrigerated tunnel to be frozen or dried. There are several types of machines on the market for this purpose, but all have to meet certain fundamental conditions to function properly. There must be a source of refrigeration. This may take the form of coils in the tunnel itself or a unit outside the tunnel. Direct-expansion coils are to be preferred for this work. Their control is simpler and quicker; they are easier to defrost; and if properly built in the first place have a very long life and are quite safe. A system of coils through which brine is circulated, which in turn must be cooled by direct-expansion coils, is sometimes used, but no one who has ever used both systems would ever want to return to the use of brine, with its corrosion and leakage problem and sluggish action.

There must be a means of distributing the refrigeration throughout the tunnel. This is usually accomplished by means of a motor-driven fan driving air over the refrigerating coils and through the tunnel in a definite channel and back to the refrigerating coils. The freezing or drying operation is then subject to two means of control: one the temperature of the air leaving the refrigerating coils and the other the volume of air passing through the channels of the tunnel and over the work as it passes through. In some cases a low temperature but a large volume of air is needed; in others higher temperature and a small volume of air; and in other cases, a very low temperature and a medium volume of air. All these requirements can be provided by a properly designed and controlled refrigerated tunnel conveyor.

If the temperature in the tunnel has been too cold, the chocolate may be cracked, or a fine mist may condense on the chocolate as it leaves the tunnel. This last condition spells loss of gloss and the early appearance of bloom. If the temperature in the tunnel has been too warm, in making molded goods, the chocolate will stick to the molds and can be removed only with difficulty; also the chocolate will be streaky, there will be a lack of gloss, or the chocolate may be actually discolored.

The wrapping and packing room should be dry; that is, of low relative humidity, to prevent the cold goods from the tunnel from sweating. The best temperature for the room generally is 65 deg. F., but in many cases even lower temperatures are desirable. This room is generally conditioned by the same refrigerating system as the dipping or molding room.

In the manufacture of chocolate and chocolate products, the use of refrigeration is widespread. The rooms in which the chocolate is brought to the proper temperature for molding, the wrapping and packing rooms, and the storage rooms are cooled by refrigeration, as are the rooms where the press cake from cocoa presses is cooled, pulverized, and sifted to make cocoa powder. Cooling tunnels similar to the ones previously described are used to mold the 10-lb. cakes of chocolate and pieces of solid chocolate of many sizes and forms.

The use of refrigeration reduces idle plant time, permits the manufacture of goods of uniform quality and attractive appearance at all seasons, prevents loss of business due to defects and inability to produce goods because of weather conditions, and is justified economically, if efficiently controlled.

Cold-Storage Practice at a Modern Warehouse

By J. LEO COOKE

Vice-President, General Cold Storage Co. Jersey City, N. J.

Celery in storage, showing arrangement to assure free circulation

IT WAS once the fashion to regard with suspicion any food product that had been in cold storage. Such storage was supposed to have some mysterious but injurious effect upon the product. What little justification such an attitude may have had in the past is certainly removed by the type of refrigerated food storage available in up-to-date cold storage warehouses. Naturally, cold storage cannot make a poor product into a good one, but it can now keep the good one in approximately its original condition over periods of time that would formerly have meant obvious deterioration.

The advances which have been made in recent years to bring about this condition are well exemplified in the new rail-to-keel warehouse of the General Cold Storage Company on the banks of the Hudson River at Jersey City. This is regarded as the largest single storage unit in the metropolitan area, having a storage capacity of over 4,000,000 cu.ft.

In considering improvements which have recently been made in cold storage practice, we are apt to concentrate our attention immediately upon problems of temperature and humidity control, air circulation, and the like, within the freezer or cooler space itself—overlooking the fact that getting the product to and from the storage space is an equally vital factor. Location of this warehouse at the water's edge, equally available to rail, water, and truck transportation, has advantages to quality of product in addition to the economy resulting from flexibility of transportation media.

Products to be stored in the plant first enter cooling rooms on the first floor where they can be brought to the desired temperature for storage. Thus the possibility of fluctuations in the temperature of the storage rooms by the introduction of goods at another temperature is avoided. Elevators with protecting flaps that prevent air circulation from floor to floor provide vertical transportation within the warehouse, and trackless electric engines designed to pull loads of 75 tons move the products horizontally. The building, of reinforced concrete construction, is eight stories high. Floors 6, 7, and 8 are primarily designed for freezer storage and 2, 3, 4, and 5 for cooler storage. Corkboard insulation in walls and floors is unusually thick.

Perishable products differ a great deal in their storage requirements if they are to be kept at optimum condition. Some must be held as low as 15 deg. below zero F., while others are kept best at 50 deg. Most products, of course, are held close to freezing temperatures, that is, 32 degrees.

Meats, poultry, and butter are usually given a sharp freeze at low temperatures when first stored and then held at a somewhat higher temperature. Dressed poultry, for example, is first given a sharp freeze at —10 to —25 deg. and then held at 0 to 10 degrees.

Apples and pears are held at 30.5 deg. as a general rule, but if tomatoes are stored temporarily they must be held at 45 to 50 deg. Still higher up the scale are bananas, which must be kept warm instead of cold. Some storage warehouses have banana rooms where temperatures are maintained around 70 degrees.

Certain products fare best with a combination of both cold and heat. The newest system of handling pears requires that they be held at low temperatures, that is, 30 to 31 deg., until ready for use. They are then put in a ripening room where temperatures are somewhat higher until the fruit is brought to just the proper eating stage.

Automatic temperature control which

All containers are held 6 in. off the floor

functions to a fraction of a degree is obviously necessary to meet these widely varying demands. Moreover, sufficient flexibility in refrigeration capacity must be had to permit economical operation of a considerable portion of the storage space at any of these temperatures, as the percentage of foods requiring any one storage temperature varies with the seasons. A brine circulation system is advantageous in this respect, the various temperatures being obtained by control of the velocity of brine circulation. The brine system also eliminates all ammonia pipes outside the engine room, thus preventing the possibility of contamination of the food as a result of leakage.

Close temperature control, however, is not in itself sufficient to assure preservation. All fruits and vegetables are living organisms and carry on respiration, absorbing oxygen and giving off carbon dioxide, whether in or out of storage. The extent of such respiration depends upon the percentage of relative humidity, degrees of heat, and the conditions of the atmosphere in which the perishable products are enveloped. It is essential for better respiration of the perishable products to maintain, in addition to optimum temperature, a uniform percentage of relative humidity normal to the product and to establish a constant internal, convective, and diffused circulation of live atmosphere.

Too high relative humidity in the air causes absorption and develops fungi, rot, and decay in the products; too low relative humidity increases shrinkage by evaporation; therefore the normal percentage of relative humidity should be established in conjunction with uniform degrees of temperature that are normal to the products under fresh conditioned live atmosphere.

Moreover, when perishable products are exposed to too high relative humidity and a vitiated atmospheric condition, such state promotes decomposition by excess absorption of moisture and develops abnormal respiration, while too low or subnormal percentage of relative humidity will develop excess evaporation, shrinkage in moisture content and loss in weight, flavor, appearance and volume of the product.

Variation in degrees of temperature causes fluctuation in percentage of relative humidity. At near-freezing temperatures when high relative humidity is required the range in degrees of temperature change is very narrow and saturation or dew point will occur if the perishable produce is of a lower temperature than that of the air, the result being that excess moisture in the air will deposit on the exterior of the product. This film of water deposited on the exterior of the product absorbs the gas given off in the respiration and tends to prevent the proper amount of oxygen from taking its place as would occur in normal respiration.

Gas given off in the respiration of perishable products being heavier than air would naturally occupy the lower strata in a room. Therefore, it is important to carry on ventilation in conjunction with an internal diffused circulation of air which is constantly moving in natural gravity formation. Such circulation, propelled by the design and arrangement of the refrigerant establishes a film of conveying atmosphere adjacent to the interior surfaces of the room. The humidified air carries the vitiating gas and heat expelled by the product, as well as the heat penetration from the exterior surface of the room to the ceiling above the refrigerant at a point where it is ventilated to the exterior, thus removing the highest percentage of humidity, gas and degrees of heat. Such ventilation relieves the refrigerant of the duty of dissipating such humidity, gas and heat, and at the same time provides a regulated supply of fresh conditioned atmosphere, the same being allowed to flow by gravity into the room through a passageway which equalizes and balances the atmospheric pressure in the interior of the room to correspond with the fluctuating barometric pressure of the exterior. Further, heat leakage through the insulation is picked up and carried by the film of air moving along the interior surfaces of the room and is conveyed by ventilation to the outside, thus making the interior non-conductive to the exterior.

The Moore system of ventilation, in conjunction with Moore design refrigeration, is used in the plant to provide this circulation and humidity control. Proper stacking of the products in the storage rooms is obviously also an important part of the task. As the illustrations show, great care is taken to permit free circulation between each container, and all products are stored 6 in. off the floor. The humidity is also varied to meet the needs of individual products. For instance, onions and celery are held at exactly the same temperature but the onions require low humidity and the celery high humidity.

Fire insurance rates for the plant are the minimum figure. In addition to general fireproof construction, a sprinkler system using calcium chloride brine is installed. The use of brine prevents the possibility of frozen sprinkler pipes in the freezer rooms.

The broadening place which cold storage occupies in food preservation as a result of the accurate control of temperature, humidity and circulation now possible is shown by the growing list of products for which it is used.

Of course you are all aware of the fact that meats, fish, butter, eggs, poultry, apples and pears and green vegetables go into cold storage. But this does not exhaust the list by any means. Fresh cream is now stored successfully, and candy, nuts also go into storage. Cornmeal and molasses are placed in storage upon occasion.

One large restaurant puts its watermelons in cold storage during hot weather to get them chilled down. This saves a lot of ice when the melons are placed on the counters. Dried mushrooms are another product found in storage.

Tests have been made recently in keeping sponge cake and pound cake in cold storage—it works perfectly. Fruit cakes and plum puddings are sometimes aged in cold storage to give them the proper flavor. Storing not only arms us against the onslaught of famine but acts as a leveler of the peaks and valleys in the price curves. It is, in short, insurance against shortages and against soaring prices.

New "rail-to-keel" terminal of General Cold Storage Company at Jersey City

Refrigerated Transportation Links Producer to Consumer

REFRIGERATED TRUCKS

REFRIGERATED trucks designed for transportation of perishable foods are classified according to the type of refrigerant used. Salt and ice mixture has long been used for refrigerating purposes and has a low initial cost. Especially is this true now when so many mechanically refrigerated ice cream cabinets are used by retailers and truck bodies are being designed for refrigerating purposes instead of for transportation of a service supply of the mixture as well.

Truck bodies using cartridges, solid CO_2, and mechanical refrigeration are of more recent development. Cartridge refrigeration has the handicap that the cartridges take up space in the truck, add weight to the load, have a relatively high initial cost, and are limited to those users having freezing rooms. However, Table I, showing comparative refrigerant costs, as supplied by K. W. Ranney, Excelsior Creamery Company, Ltd., Santa Ana, Calif., gives eutectic refrigerants an extremely low material cost to counterbalance the less favorable factors of deadweight and initial cost. All ice cream manufacturers have hardening installations that can be used to freeze the solutions.

Table I—Refrigerant Costs

	Solid Carbon Dioxide	Cartridge Eutectic Solution	Ice and Salt
Cost per pound.....	$0.06	$0.0025	$0.0021
"Effective B.t.u." per pound at 10 deg. F...	245.	142.	85.
Pounds of refrigerant per 1,000 B.t.u.....	4.08	7.04	11.88
Cost of refrigerant at plant per 1,000 B.t.u.	$0.245	$0.0176	$0.0247

Mechanically refrigerated truck equipped with unit that has a power take-off from the truck engine or may be operated by a.c. auxiliary motor when in garage. Generator for refrigerating unit gives constant voltage at all engine speeds

Table II—Refrigerated Trucking Costs

Pay Load		Body Weight (Includes Refrigerant)		Chassis Rating		Truck Cost Per Day*		Refrigeration Cost Per Day		Total Direct Cost Per Day*		
Meat	Ice Cream	"Dry-Ice" Lb.	Ice and Salt Lb.	"Dry-Ice" Tons	Ice and Salt Tons	"Dry-Ice"	Ice and Salt	"Dry-Ice"	Ice and Salt	"Dry-Ice"	Ice and Salt	Saving Per Day†
1,800 lb.	200 gal.	1,500	2,600	1	1½	$6.60	$8.40	$1.70	$1.70	$8.30	$10.10	$1.80
2,700 lb.	300 gal.	1,600	3,130	1½	2½	8.40	10.20	2.00	2.10	10.40	12.30	1.90
3,600 lb.	400 gal.	1,900	3,710	2	3	9.60	12.00	2.60	2.80	12.20	14.80	2.60
4,500 lb.	500 gal.	2,400	4,300	2½	3½	10.80	14.40	3.00	3.40	13.80	17.80	4.00

Price basis for ice and salt is 20 per cent salt at $12.00 per ton and 80 per cent at $4.00 per ton.
Price basis for "DRY-ICE" is $0.06 per pound which includes delivery and handling costs.
*Based on 60 miles per day.
†Does not include many indirect savings. Increases with increased daily mileage.

Approximately 2,000 trucks employing solid CO_2 have been put into use within the past three years, because they offer the advantages of low deadweight load and high capacity pay load as well as temperatures from freezing to —30 deg. F. and elimination of corrosion and moisture. Comparative costs of operation as determined by D. H. Killeffer, DryIce Corporation of America, New York, N. Y., are given in Table II.

This coil-lined truck body made of Duro-Aluminum weighs only 4,000 lb. and has capacity for 350 gal. of ice cream in bulk

Truck bodies employing solid CO_2 as the refrigerant fall into two general classes. The older type has the supply of solid CO_2 within the truck body itself. Originally the refrigerant was placed inside the truck along with the pay load. This method was unsatisfactory because the refrigerating effect was not distributed uniformly throughout the chamber and because the gaseous CO_2 with whatever impurities it might contain came in direct contact with exposed food products that would absorb the odors of impurities. In later developed trucks, such as built by Anheuser-Busch, Inc., the refrigerant is placed through an outside hatchway into a suspended bunker compartment built in the roof of the body and connected with ducts to permit the cold gas to circulate around the body and escape into the air. The refrigerant thus employed imparts a more uniform refrigerating effect to all parts of the interior of the body. The block of refrigerant thus exposed on all sides gradually assumes the shape of a diminishing pyramid. These trucks range from one to three refrigerated compartments and from 115 to 780 gal. capacity for ice cream or 37½ to 156 cu.ft. capacity for food products.

The new type, as illustrated by the body built by FitzGibbon & Crisp Com-

Refrigerated trailer bodies used by motor express companies to deliver perishable foods to retailers

pany, employs the fin principle of cooling. The supply of solid CO_2 is placed in a centrally located compartment, insulated on five sides, in the roof of the body exterior to the body chamber but in contact with it by a temperature conducting metal sheet that forms the inner layer of the roof construction. This method of application is said to give a uniform temperature throughout the body of as low as —30 deg. F., if desired, as long as there is a one-piece layer of refrigerant in the refrigerating compartment. Because the block of refrigerant comes in contact with the interior temperature of the body on the under side only it maintains its solid rectangular form and exposed surface area as long as the diminishing block remains in one piece. The resulting gas gradually escapes around the closure of the loading hatchway.

Convertible bodies such as those produced by Meyer Body Company, Inc., find application in the ice cream industry. They are equipped with overhead refrigerant tanks connected by circulating pipes and filled from the top. When ice and salt mixture is used, the front tank is loaded with the mixture and the rear one contains the cold brine with circulation between the tanks. An automatic overflow eliminates necessity of draining and cleaning and prevents brine from coming in contact with body or chassis. An initial load of 600 lb. of mixture with an addition of 150 to 250 lb. of salt and ice daily supplies the necessary refrigeration for one with a capacity of 420 gal. ice cream.

If dry refrigeration becomes desirable, the tanks are charged with a total of 30 to 40 lb. solid CO_2 per day without any change in body construction. Bodies of this type can be supplied in capacities of 280 to 650 gal. of ice cream, equivalent to 1,960 to 4,550 lb. pay load.

Refrigerated bodies such as used by Fruehauf Trailer Company on its new semi-trailers serve to close the gap between carload shipments and delivery truck service. Solid CO_2 is the refrigerant in this body, which is $14\frac{1}{2}$x$6\frac{1}{2}$ ft. and designed to handle less than carload lots of perishable products throughout territories formerly served by railroads.

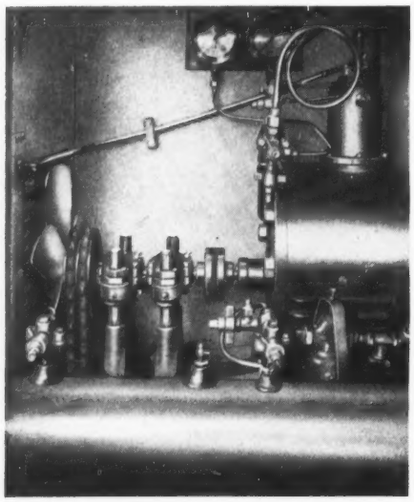
Mechanically refrigerated trucks are of so recent development that body manufacturers thus far have been building them only on special orders. These trucks, like those of the other types, are at present used largely in the ice cream industry but are becoming of greater interest as merchandising of frozen food products increases in importance. The features that have tended to discourage their use are the weight of the refrigerating unit, which cuts down the pay load, and the effect of the truck vibration on the refrigerating unit.

Mechanically refrigerated trucks such as manufactured by General Motors Truck Company, are cooled by a radiator-cooled twin-cylinder engine that is connected directly to the compressor by a 3:1 gear reduction and a flexible coupling or by a vari-speed generator that is driven by the truck engine through a power take-off that actuates a d.c. motor to run the compressor. When the truck is not on the road, an a.c. motor in the latter type truck operates the compressor from the house current. The vari-speed generators are said to produce a constant voltage and maintain the desired temperature regardless of engine speed during a trip. These trucks have a capacity of from 250 to 700 gal. of ice cream; a straight rating of from 11,000 to 18,500 lb. for the chassis.

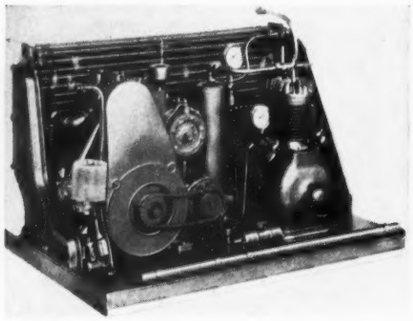
Another type of mechanically refrigerated body that gets its compressor power directly from the truck motor by means of a power take-off is that manufactured by Motor Vehicle Refrigeration, Ltd. The compressor in this body is said to operate efficiently at speeds varying from 200 to 2,200 r.p.m. and is compactly designed to stand the vibration of motor travel.

The refrigerant is methyl chloride and the refrigerating unit is so organized that the whole refrigerating mechanism occupies only 30 cu.in. of space. It is reported that a 350-gal. bulk capacity body mounted on a Ford chassis maintained a temperature of —8 to —10 deg. F. when running and a loss of only 2 to 4 deg. F. when the engine was idle. When operated over a route for a 5-month period formerly served by a truck using ice and salt, a truck fitted with this type body is re-

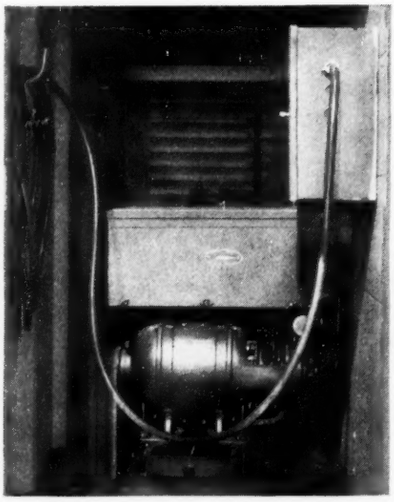
This refrigerating unit, made by Fourness Development Company for truck body installations, is of ½ ton capacity and is compactly built to eliminate jarring action of the truck



A compact, self-contained truck refrigerating unit that operates independently of the truck engine and produces refrigeration equivalent to 800 lb. of ice



View of refrigerating unit driven by T. & J. vari-speed generator which may be powered from the motor truck engine or from house current when the truck is in the garage



ported to have showed a saving of $14 per day; depreciation on neither truck was included in the calculation. Bodies of these types are now used for ice cream delivery but are planned for use in merchandising other frozen food products.

A mechanically refrigerating unit employing the cooling fan principle has recently been developed by the Safety Refrigeration, Inc., for application to motor trucks and trailers. Its compressor and condenser cooling fan are driven by a small gasoline motor that is automatically controlled to give desired refrigeration temperature. The larger capacity machine of the two sizes is advocated to produce and maintain a refrigeration temperature of 0 deg. F. in a well-insulated body 17x7x6 ft. dimensions and from —10 to —20 deg. F. in smaller bodies.

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REFRIGERATOR CARS

GRADUAL replacement of the familiar iced refrigerator car by self-refrigerating units is not the impractical and visionary feature that it seemed a few years ago. It is undoubtedly true that, from the standpoint of cold economics, a modern iced-bunker type "reefer" is still the cheapest means of transport for most refrigerated shipments. But the success of the newer methods for shipment of special classes of goods, both fresh and frozen, is just as definitely proved.

The establishment of Safety Protective Service, for which uniform tariff regulations became effective on March 2 on 20,000 miles of American railways, is a case in point. Iceless cars containing silica gel refrigerating equipment and auxiliary heating units, both under thermostatic control,[1] permit the shipper to name the average degree of temperature he desires to be maintained throughout the entire trip. Even in tests under violent atmospheric fluctuations (see Fig. 1), temperature variations within the car have rarely been more than three degrees. Overhead refrigeration eliminates the large temperature differences between different parts of the car that ordinarily exist with ice bunkers located at the extreme ends.

Cars are ready for loading a few hours after the thermostatic control is set. At intervals of 36 to 48 hours, as the cars pass through regular service stations, they are examined by inspectors, who report to headquarters the temperature of air in the car as recorded on a tape. Elimination of delays for reicing obviously is one of the chief advantages. In cases where unloading has been delayed for one reason or another, cars have stood in the yards for as long as ten days without variations from the thermostat setting.

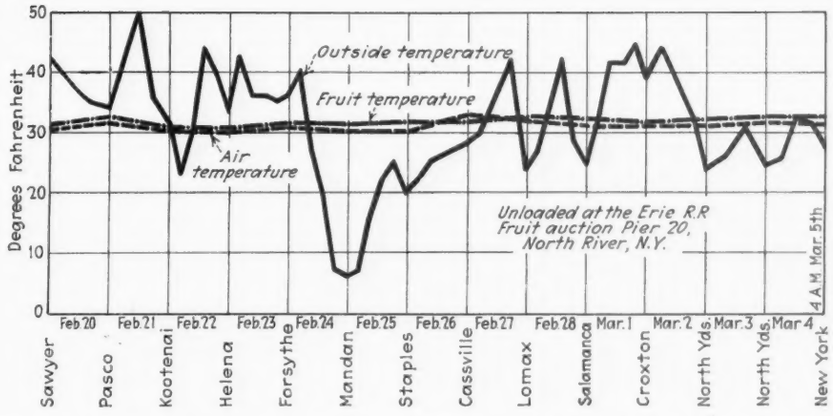


Fig. 1—Test shipment of 756 boxes of pears from Yakima Valley, Wash., to New York City in silica-gel refrigerator car. Test under direction of U. S. Department of Agriculture

This type of car has transported to date more than 50,000,000 lb. of perishable commodities, more than 50 per cent of which have been quick-frozen products. Temperatures at which these quick-frozen shipments were handled ranged mostly from 12 to 17 deg. F., and, in a few instances, lower. Choice shipments of fresh fruits, and dressed hogs coming to Eastern markets from packing plants in the Middle West, have also been shipped in this type of car with complete economic justification. The estimated value of products transported to date is about $14,000,000, and the total losses from all causes do not exceed $4,000. Eighty-six of the cars are now in operation, and additional units are contemplated for the near future.

Axle-Driven Compressors

A number of cars using mechanical refrigeration driven from the axle have also been put into commercial use by the North American Car Corporation, after six years of development work. The first of these "Frigicar" units went into the service of G. A. Hormel Company in 1929, and with the experience gained in its operation, a number of improvements were developed.

In 1930, five more units were completed, four of which were sent upon the road and one was retained as a laboratory for the development of new ideas. These cars have now traveled an aggregate of more than 30,000 miles and have in all cases delivered their ladings in excellent condition. Sixty additional units are now being equipped.

The "Frigicar" makes use of a standard compressor system of refrigeration, using ammonia as the refrigerant. When stationary the compressor may be put in gear with an electric motor by the operation of a clutch. Power is taken from an alternating current of either 220 or 440 volts. However, the motor is seldom used except for precooling purposes or for storage purposes at terminals where it is desired to hold a loaded car for a week or ten days. For reserve of refrigeration when the car is standing in the yard or on a siding, a brine tank at each end of the car is provided in which is approximately 5,600 lb. of brine. When the car is in transit or operated by the motor, this brine is frozen, producing sufficient reserve refrigeration to hold the car at a stationary temperature when not operating from 50 hours upward once the lading is cooled.

The car is equipped with an air-cooled condenser upon the roof. Inside the car there are expansion coils in the rear of, in front of, about, and inside the brine tanks, through which the refrigerant flows in series. The car is equipped with a thermostatic control valve, by means of which the car temperature is regulated. There are check valves on all lines underneath the car, so that in the event of a derailment, the major portion of the ammonia charge will be saved. All brine drip has been eliminated, as the brine tanks are sealed. The installation requires no more space inside the car than that occupied by the ordinary brine tanks or bunker type of refrigeration with ice.

Dry-Ice Car

A third departure from the conventional ice car has been developed cooperatively by the American Car & Foundry Company and the DryIce Corporation of America. A 40-ft. steel car of practically standard dimensions but heavily insulated with 7 in. of Dry-Zero insulation was constructed early in 1930 and has been engaged in handling meat, eggs, ice cream, and frozen foods in an experimental way.

The Dry-Ice is contained in two heavily insulated metal bunkers at the upper ends of the car. These bunkers are gas-tight and provided with an effective means of introducing into the lading space only the quantity of carbon dioxide gas found to be advantageous. Close temperature control is established by means of a thermostatically operated damper which controls the circulation of air through the radiators. The

[1] "Temperature Control in Railway Refrigeration," by Horace M. Wigney, *Food Industries*, Vol. 2, No. 4, p. 182.

bunkers will carry a 3,000 lb. charge of Dry-Ice, sufficient to refrigerate the car from 6 to 15 days without re-icing. Temperatures maintained have been adjusted to meet the desires of the shippers, and have ranged from 40 deg. F. in a typical load to —20 deg. F. in an extreme case of frozen-product transportation. In all runs, temperature control has been satisfactory. In the best runs, temperatures from top to bottom of the load, after the first ten hours, were maintained constant within plus or minus 3 deg. F. for 11 days. In the worst, temperature variations within the load were less than plus or minus 5 degrees.[2]

The present price for solid carbon dioxide undoubtedly is a limiting factor in the extension of this method of refrigerating railway cars. It has been estimated that if 25 per cent of fruit and vegetable shipments moved under such refrigeration, the production volume of solid CO_2 would be sufficient to reduce the cost to a level competitive with water ice. Naturally, no such volume for this purpose is going to spring into use over night. Increased use of this type of car probably will depend to a large extent upon the reduction in cost of solid CO_2 arising out of increased production for purposes entirely foreign to car refrigeration.

Iced Cars Improved

Less spectacular, perhaps, but no less important to the current status of refrigerated transportation, are improvements in the design and operation of the ordinary iced refrigerator car that are continually being put into practice. Improvements based on a more scientific view of air circulation are of particular interest. Shipping containers so designed that structural provisions to eliminate physical damage to the product in transport do not conflict with proper air circulation are an obvious corollary to these findings.

Better insulation—balanced on top, walls, and floors in relation to the different temperature conditions to which each is exposed—appears to be a real source of economy in the newer refrigerator cars. More efficient doors, floor racks and the like, and stricter maintenance to prevent refrigeration wastes that formerly were common, appear to be justifying themselves on economic grounds.

The Great Northern Railroad is now building at the rate of one car a day, refrigerator cars that are different from the ordinary in size. These cars are 42 ft. 6 in. between ice bunkers and 48 ft. $7\frac{7}{8}$ in. from end to end with the ice bunkers collapsed. They have a capacity of 125,000 lb., including ice and salt, and about 100,000 lb. of load. The bunkers collapse and fold up against the roof of the car when not needed. Floors, walls, and ceiling are insulated more heavily than usual, and the doors are 7 ft. high and 5 ft. wide. These cars have been used for shipping frozen fruit from the Northwest to Eastern markets successfully.

Milk Tank Cars

Glass-lined refrigerator tank cars for milk shipments also have shown considerable development in recent months. Sheffield Farms Company, New York City, which has recently added twelve new cars of this type to its facilities, now has tank cars with a total capacity of 1,800,000 qt. of milk. There are nearly five hundred cars of this type in use throughout the United States.

The cars are equipped with two 3,000-gal. glass-lined seamless tanks, well insulated and mounted in a patented cradle mounting (See Fig. 2). The surface of two 3,000-gal. tanks is about one-fifteenth of the interior surface of 600 10-gal. cans, an obvious sanitary advantage, and one tank car will haul about the same amount as three cars hauling cans. For ordinary runs, the pre-cooled milk is sufficiently well insulated to eliminate the need for further refrigeration.

The degree to which ice and salt refrigeration will be supplanted by other means, such as the silica gel car, is still an open question. Some significant indications undoubtedly will be revealed by a number of tests on the shipment of frozen products now being carried out by Merchants Dispatch, Inc., Rochester, N. Y. Some typical shipments upon which this organization bases its opinion that frozen products can be refrigerated with ice and salt, with entire commercial satisfaction and at lower cost than other means, if a properly insulated car equipped with basket bunkers and floor racks be used, are shown below:

1. Frozen peas transferred a distance of 327 miles. Initially iced and re-iced at point of origin, crushed ice and 15 per cent salt; re-iced once in transit. Air temperature of car at destination in doorway, 18 deg. F. Peas were frozen solid.

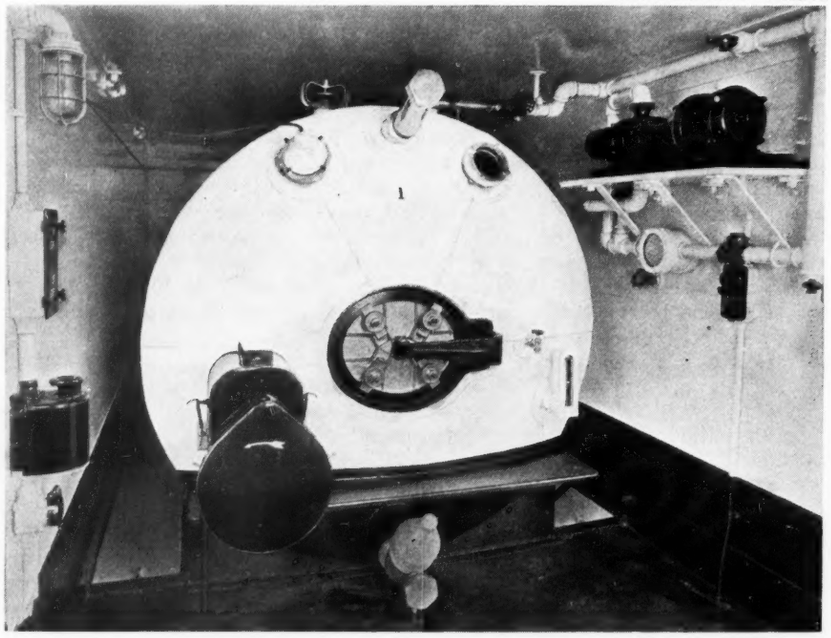
2. Car containing frozen raspberries, peas, and corn, transported 645 miles. Initially iced with crushed ice and 20 per cent salt, re-iced at all regular icing stations in transit. Car had temperature of 24 deg. F. at bottom and doorway at time of inspection two days after arrival at destination. Car was not re-iced for a period of 69 hours prior to inspection at destination. Commodities were frozen solid at time of delivery.

3. Frozen fish transported a distance of 796 miles. Initially iced before loading with crushed ice and 20 per cent salt. Re-iced at loading point, before forwarding, with 20 per cent salt, and re-iced once in transit with 20 per cent salt. Product arrived at destination frozen solid; temperature of floor and doorway 10 deg. Car cooled rapidly after loading and for 56 hours had a variation of only 1 deg. in temperature.

In the test temperatures as low as 2 deg. above zero, were obtained, with but small fluctuations. This is attributed to the method in which unbroken massed insulation is applied to this equipment, and to the fact that the equipment is heavily insulated, having from 2 to $2\frac{1}{4}$ in. of standard insulating material in the floor and sides and $2\frac{1}{2}$ to 3 in. in the roof. Further experiments are under way to determine just what temperatures are necessary to ship specific frozen products without deterioration, and to determine how well refrigeration by ice and salt can meet these demands.

Fig. 2—Interior of milk-tank car, showing one of the two 3,000-gal. glass-lined tanks

General American Car Company



[2] "Transporting Perishables With 'Dry-Ice,'" by C. L. Jones, *Railway Age*, Vol. 90, No. 7; Feb. 14, 1931; p. 363.

What Happens During Quick-Freezing

By HARDEN F. TAYLOR
President, Atlantic Coast Fisheries Company
New York City

OF THE four fundamental methods of artificial food preservation—dehydration, heat sterilization, chemicals, and refrigeration—a good case can be made out in favor of refrigeration as the most nearly ideal. The grounds for this claim are that refrigeration neither adds to nor takes from the food any material substance, and it leaves the food in a condition more nearly approximating its natural condition than any other preservative. It does not destroy or inactivate vitamines or tissue enzymes. But the realization of such an ideal preservative has been beset with numerous practical difficulties, conspicuous among which, but not by any means alone, is the tendency of frozen watery comestibles to lose a large quantity of juice on being defrosted, with consequent loss of some nutriment and much flavor. The attendant loss of weight is a serious commercial problem, while the final product is dry and insipid.

About 1912 and 1913, methods of freezing fish rapidly by direct immersion in cold brine were introduced on a small commercial scale in Norway and Denmark. Investigations in Germany revealed that in the fish rapidly frozen by these methods the grain size of ice crystals formed within the tissues was very small, in contrast with the relatively large grain size of ice in slowly frozen fish, and that, within a limited time after freezing, loss of juice was much less.

Properly interpreted, this discovery has not only opened up a new and important field of research but is a distinct advance in the practical science of refrigeration, effecting, as it does, great improvement in one of the numerous steps between raw material and delivered product. Large crystals do form in slowly frozen products, and these crystals dislocate and otherwise do damage to cellular tissues.

But this discovery has been interpreted as the beginning and the end of refrigeration technique, and around it has been built a fantastic edifice of explanation, running about as follows:

> Fish, meats, etc., contain from 60 to 80 per cent water. When they are frozen slowly, the large ice crystals formed lacerate cell membranes so that juice can, and does, escape; but when the freezing is done rapidly, the very small crystals formed are contained within the cells and do not puncture the membranes; the juice, therefore, cannot escape. If quick-freezing is good, quicker freezing is better; if

low temperatures freeze quickly, lower temperatures freeze more quickly. Therefore, the method which freezes extremely quickly and at extremely low temperatures is best of all.

This naïve mechanical interpretation of the phenomena of freezing is largely erroneous, though for purposes of popular magazines and financial "dope sheets" it has the advantage of simplicity and plausibility. Rapidity is only one of numerous variables in freezing, and freezing is only one of the several steps comprised in the whole art of preparing, freezing, packing, storage, transportation, and distribution of foods under refrigeration. Each of these steps is likewise subject to numerous variables and presents problems worthy of serious scientific study. On the basis of the above plausible reasoning, money is being invested, plants are being built, and elaborate preparations are being made for large-scale operations seemingly with little regard for the fundamentals. The disappointment that is likely to follow from exaggerated expectations can scarcely fail to retard the orderly advance of refrigeration through research.

If laceration of cell membranes is the cause of drip from slowly frozen flesh, we should likewise cause drip if we lacerate these membranes by physical means other than ice crystals. It is common experience that meat does not drip juice when it is ground, however fine, as sausage, nor does liquid exude from the cut surfaces of meat. It is impossible to squeeze out more than mere traces of juice from fresh fish or meat, even under high pressure. Fresh fish flesh, ground with mortar and pestle in the presence of powdered glass, does not yield juice, even under pressure, though the cellular structures are extensively destroyed by the treatment. It is evident, therefore, that the cell contents of fresh fish and meats are not in condition to run out from the cells, and the integrity of the cell membrane is not the criterion—certainly not the only criterion—of drip. In fruits and vegetables, however, it is obviously true that mechanical destruction of the tissues does release juice, for, with slight pressure, juice can be squeezed from almost any product of plant origin.

By way of disproving still further the mechanical theory of drip, the writer has demonstrated elsewhere[1] that while juice cannot be removed in more than traces from fresh fish, it flows out spontaneously in large volume from fish that have been frozen for some time, and that this volume bears little, if any, relation to the rapidity of freezing. In fish, the quantity of juice set free bears a relation to the length of time in the frozen condition, for the volume is very small immediately after freezing, but increases to a maximum in about 60 days under ordinary storage conditions. On the other hand, strawberries buried under powdered carbon dioxide, frozen in a few seconds, and defrosted at once, softened and yielded copious juice spontaneously. These and many other easily ascertainable facts are entirely out of harmony with the theory that mechanical injury incident to slow freezing causes loss of juice. Large ice crystals are supposed to release juice by mechanical injury, yet the severest mechanical injury fails to bring forth the juice from fish. Quick-freezing is supposed to avoid the injury and hold the juice in, yet in quick-freezing of both fish and berries we get much juice. A more satisfactory understanding of what really happens in freezing would certainly be a safer foundation for a new industry.

The true explanation of what happens will be found in the province of colloid chemistry, rather than mechanics. The cell contents of animal tissues consist of a colloidal solution, in water; of proteins, mainly albumens and globulins, in association with various inorganic salts of sodium, calcium, potassium, and their

[1] *Food Industries*, Vol. 2, No. 4, pp. 146-151, April, 1930; Proceedings of the Divisional Meetings of the Institute of American Meat Packers, held at Chicago, Feb. 20, 1930, and New York, March 6, 1930, pp. 17-44; *Ice and Refrigeration*, Vol. 79, pp. 111-121, August, 1930.

ions, and with acid or base; i.e., with a certain amount of hydrogen and hydroxyl ions. This complex solution, containing upward of 80 per cent of water, under certain conditions can be a thin jelly, perhaps resembling the raw white of egg. When it is gelatinous it cannot flow out of the cells, even if they are ruptured. But if the jelly is, in whole or part, converted to liquid, the liquid can escape from the tissue.

In the behavior of frozen foods with respect to loss of juice we are, therefore, mainly concerned with colloidal protein systems and the conditions under which they are converted from liquid to gel or gel to liquid, coagulate, or separate into heterogenous systems. These conditions involve many factors. The gels are sensitive—some of them extremely so—to a variety of influences both internal and external. Among these influences that may cause a jelly to coagulate, liquefy, or become more rigid are the concentration and nature of the several proteins present, the presence and nature of inorganic or mineral salts, the alkalinity or acidity, temperature, and the effect of enzymes or ferments. One of the characteristics of these proteins is that they are soluble in water in the presence of moderate but not excessive amounts of inorganic salts which are present in the cell substance, but if the concentration of salts becomes excessive, they are precipitated from solution, the globulins more easily than the albumens. This phenomenon is known as the "salting out" effect.

When freezing occurs, the separating ice is pure crystalline water, so that the remaining unfrozen liquid is a more concentrated solution. As freezing continues, the unfrozen portion becomes more concentrated, so that first the globulins and finally the albumens (if the temperature is sufficiently reduced) may be salted or precipitated out, leaving a thin liquid. At certain concentrations of salt some protein gels are liquefied or "peptized." These phenomena are mentioned here to illustrate some of the factors that affect the stability of gels. Experimental evidence indicates that neither salting out nor peptization is the direct cause of loss of juice from frozen fish.

The presence and concentration of acidity or alkalinity also has a marked effect on the behavior of proteins. At a certain degree of acidity, the iso-electric point, which is specific for each individual protein, the protein is at its minimum solubility, viscosity, osmotic pressure, and surface tension, and is most easily precipitated by salts. The presence of salts with the proteins shifts this point of minima in the direction of more acidity. Fish and meats have at death, or soon thereafter, an increasing acidity, attendant especially on *rigor mortis*. This increasing acidity, or *pH*, tends toward increasing instability of the gel condition.

Another characteristic of proteins is their inability under certain conditions to hold in bondage as a jelly all the water they have taken up. When this condition comes about, the jelly shrinks and squeezes out a thin fluid which contains less protein than the original jelly. This phenomenon, called syneresis, also depends on the nature and quantity of protein, time, acidity, alkalinity, presence of salts, etc.

A third means by which the cell jelly can be converted into a free flowing liquid is autolysis, or self-digestion. The tissues of animals contain ferments, like pepsin, which are able to liquefy or digest gelatinous proteins. It has been shown that acidity and also bruising or damaging of cell structures favor autolysis. Autolysis is a chemical process in which time is concerned. At warm temperatures it is rapid, while at the low temperatures of frozen storage it is very slow. If we attempted an explanation of loss of juice by assuming the salting out of protein by strong brine in the frozen cells or the contraction of the jelly and squeezing out of the thin dilute liquid, we would still be unable to account for the escape of juice through the cell membrane undamaged by quick-freezing, or to account for the time element in the escape of juice. Autolysis seems able to offer a possible explanation, in that it may digest the cell membrane or increase its permeability. This would let the juice out of an otherwise undamaged cell; time would be required for it to do so, and this time would be prolonged at the low temperature of storage—all of which agree with what we actually observe.

A corrective treatment has been worked out, and used successfully by The Atlantic Coast Fisheries Company, on the basis of these physico-chemical principles, in so far as animal tissue cytoplasm is concerned. For fruits it is quite out of the question, for the reason, if for no other, that fruit juices are not gels and possibly cannot be made gels *in situ*. Fresh fruits are preserved by the best of all preservatives, life. Freezing kills the fruit, and permits rapid decomposition of the fruit after it is thawed.

No attempt has been made here to give a complete exposition, which would require a volume; but enough has been said, perhaps, to show that the advance of freezing as a new preservative agent should conform to a knowledge of what really happens when foods freeze.

Quick-freezing is a valuable contribution to the art of preserving food by refrigeration, but is by no means the whole art. It appears to be chiefly important in maintaining general appearance and firmness of animal tissues. It does not prevent loss of juice, but loss of juice from animal tissues can be prevented by other means.

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Frozen Sliced Apples

ONE of the 1930 developments in the application of freezing was the appearance of frozen sliced apples, produced by B. C. Coons, of Rochester, N. Y. In the absence of specific details, only general information is available.

Apples are peeled and sliced according to well-established methods and placed in oil-paper cartons or tins, as shown in the illustration. No information is available as to possible methods of treatment of the sliced apples to prevent darkening, such as are employed in the canning industry. For freezing, the filled containers are placed in sharp freezer rooms at temperatures between 0 to 20 deg. F. Freezing times are not stated.

Advantages claimed by the inventor are savings in costs of containers, for 50-lb. oil-paper cartons are used instead of hermetically sealed No. 10 cans, when the comparison is made with the cost of canning. When contrasted with shipment and storage of fresh apples, considerably larger cost savings are claimed through avoiding barreling, transportation, and storage charges on the waste fraction of the apple that is normally lost in peeling, amounting to 33 per cent.

Several styles of package in which frozen, sliced apples are prepared

Freezing Cream for Storage

By ROSCOE A. PAGE
Kraft-Phenix Cheese Corporation
Chicago, Ill.

THE freezing and storage of cream is not a merchandising proposition but fundamentally one of storage in times of surplus to carry to times of shortage for use later in manufacture. Thus the usual problems of final texture, body, and appearance are less important, and more emphasis must be placed on flavor, bacteria count, and general quality as a raw material to be further processed.

In the early history of the freezing of cream, cream was placed for storage in ordinary 8- and 10-gal. milk or cream cans. Cream thus frozen, however, is difficult to remove from the package, damage is likely to result to the can, and the container is too expensive for any long period of holding. It was desirable to provide a smaller package and one with straight or sloping sides, so that the contents could be easily withdrawn, and butter tubs and wide-topped tinned containers were used.

Little cream is now frozen in wooden butter tubs, as suitable well-tinned containers are available from the leading can companies. Improvements in the construction of tinned cans have been made and are being made to provide flush soldered seams and to avoid creases and crevices in the inside of the surface of the container which might harbor bacteria and damage the product. The ideal can is one that has as smooth an interior as possible, that can be properly sterilized before use, and that presents no lodgment for bacterial contamination. The containers commonly used are of 5 or 6 gal. capacity, holding from 45 to 50 lb. of cream. They are from 9 to 13 in. in diameter and from 15 to 22 in. deep.

The smaller diameter can freezes more quickly, and speed in freezing is essential to the final quality of the product. Some cold storages provide special freezing rooms with air at —25 to —30 deg. F. being circulated among the cans. Freezing in such a room takes place in a few hours. The cream can then be removed into a holding storage temperature of from —7 to —10 deg. F. In other storages, the cream is frozen more slowly at temperatures from —12 to —17 deg. F., the cans being loosely piled to permit air circulation until freezing is complete and then closely piled in lots in the same room.

There are different percentages of butterfat in the cream as stored, and, other things being equal, the higher percentages of fat present a better keeping quality. It is important that the cans be well filled, excluding as much air as possible from the package, and also that the filling of the cans take place without the production of foam, which incorporates considerable air in the cream and gives rise to oxidation. Only cream of high quality, of low bacteria count, and low acidity will keep satisfactorily over a somewhat lengthy period of time Cream being largely butter fat and a product in which enzyme growth and development does not figure, it follows that the storage process does not and cannot improve upon the initial quality.

Good cream, properly handled, can be stored for a period of a few months, and with careful attention to manufacturing processes, be successfully used, especially if blended with current, fresh production. Defrosting should be carried out as quickly as possible upon usage.

The practice of freezing and storing cream is carried on by the larger producing and manufacturing dairy firms, but not to as large an extent as in recent years. There has been some excellent research by a few of the state colleges on the keeping quality of frozen cream, types of containers used, and quality of resulting products, but there is still a considerably larger contribution that might be made by intelligent research.

Cans of frozen cream piled in refrigerated storage room

Fig. 1—Cold storage plant, on deep water at Tampa, where Borden and National Juice Corporation began freezing orange juice in 1931

Florida Produces Frozen Orange Juice

By L. V. BURTON
Editor, Food Industries

THE two largest dairy companies in the United States entered the frozen orange juice business in 1931 at Tampa, Fla., and have brought with them all the fine technology for which the dairy industry is noted. Their methods of operation would be surprising to one accustomed only to the usual methods of fruit preservation, for the dairy people recognize in orange juice a product as delicate as milk, to which they have been long accustomed.

Juice from sound oranges is a sterile product and all efforts are directed to keeping it as near to its original condition as possible. It possesses, however, certain enzymes that are responsible for a form of non-bacterial deterioration which will occur even when the juice is frozen. Both Borden's and National Dairy Products Corporation, through its subsidiary, National Juice Corporation, utilize methods of protecting the juice from oxidative processes by as complete removal of the air as is possible before freezing.

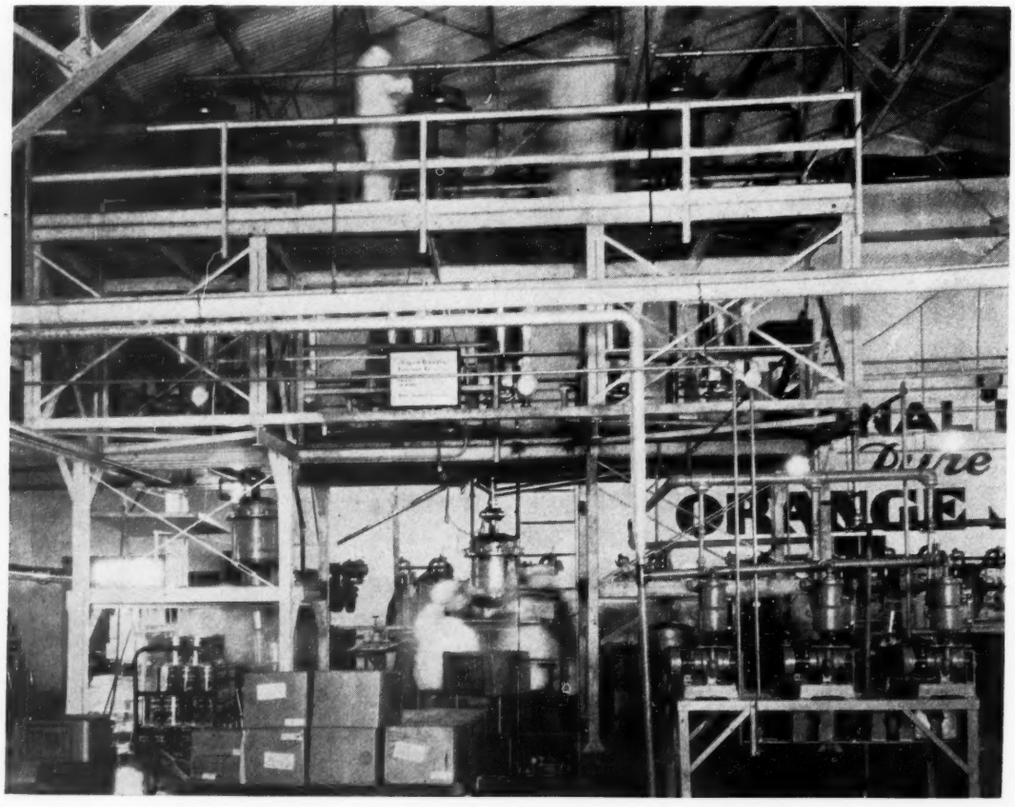

Fig. 2—General view of the modified Grayson system of freezing at National Juice Corporation. Juice is de-aërated on the upper deck, frozen to slush in the vacuum ice cream freezers on the middle deck, and is filled at the floor level

Methods of preparation of the oranges, their inspection and peeling, the method of juice extraction, and its subsequent de-aëration will be described in greater detail in later issues of FOOD INDUSTRIES. Only the methods of freezing will be described briefly in this article.

NATIONAL JUICE PRE-FREEZES IN VACUUM

National Juice Corporation de-aërates the juice by a modification of the Grayson process and freezes it to a slush of the consistency of sherbet in a 27-in. vacuum in vertical ice cream freezers from which the beaters have been removed. The slush is forced out of the freezers by nitrogen gas into a gang-filling machine, from which it is filled either into waxed-paper cups or into gallon tin cans which are then sealed in vacuum. The object of the pre-freezing is to prevent separation of fibrous material during the air-blast freezing process, also to take up part of the load of freezing and to arrest any possible micro-biological action that might occur during the early stages of freezing.

Final hardening is done in an air blast at —10 deg. F. in freezing rooms shown in Fig. 4. In paper cups the pre-frozen juice is loosely packed in onion crates. The hardening period requires about 6 to 12 hours, while the pre-freezing period requires only 6 minutes. Temperature of the slushed juice going to hardening rooms is between 28 and 29½ deg. F.

Shipping containers are corrugated KT paper containers. Shipments have been made by steamers having low-temperature rooms, by refrigerator cars chilled by ice and 20 per cent salt.

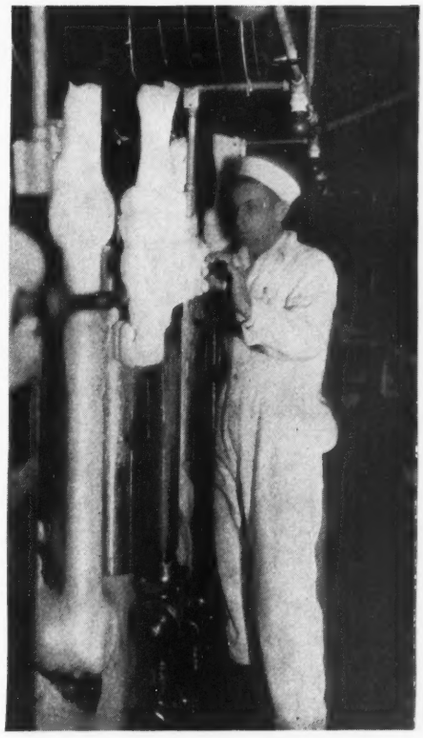

Fig. 3—National Juice pre-freezes the de-aërated orange juice in these York vertical ice cream freezers, designed to operate on a 28-in. vacuum. Refrigeration is by the flooded ammonia system

BORDEN COMPANY OPERATIONS IN TAMPA

Borden's fills the prepared de-aërated juice, which has been cooled to about 40 deg. F., into Sealcones and freezes in this container in a machine designed and operated by Sealcones, Inc., located in a separate wing of the plant of the Tampa Union Terminal. Borden washes the oranges in a sodium hypochlorite solution to sterilize them, expresses the juice in a Skinner automatic juice expeller, and de-aërates it in a Bristow and Pipkin system, details of which FOOD INDUSTRIES hopes to be able to present in the near future, as soon as certain patent matters have been cleared up.

The filled and sealed paper bottles are hooked onto the conveyor of an "Inver" freezer and pass slowly downward into calcium chloride brine, but are never quite submerged (see Fig. 6). During the first 30 in. of forward movement, after the containers have reached the brine, they dip only 2½ in. into it. In the next 15 ft. they dip slowly to 4½-in. immersion and remain at that level until they come out. Because of the paraffin surface of the container very little brine adheres to it and it is removed by a brief immersion in water, occupying not more than 2 seconds.

Freezing is regulated to conform to a theoretical formation of ice, as shown in Fig. 7. Fig. 8 shows how closely the theory is paralleled. It is necessary to freeze in this way to avoid straining the package; also to increase refrigerating efficiency, which is greater with the bulk of liquid well below the brine surface.

Temperature of the refrigerant is held at about —10 deg. F., depending on the load. At this temperature the freezing time is 32 minutes, with a total period in the freezing machine of 40 minutes. Freezing can be done fairly satisfactorily with a brine temperature as high as zero. As soon as the containers of frozen orange juice are rinsed they are packed in corrugated

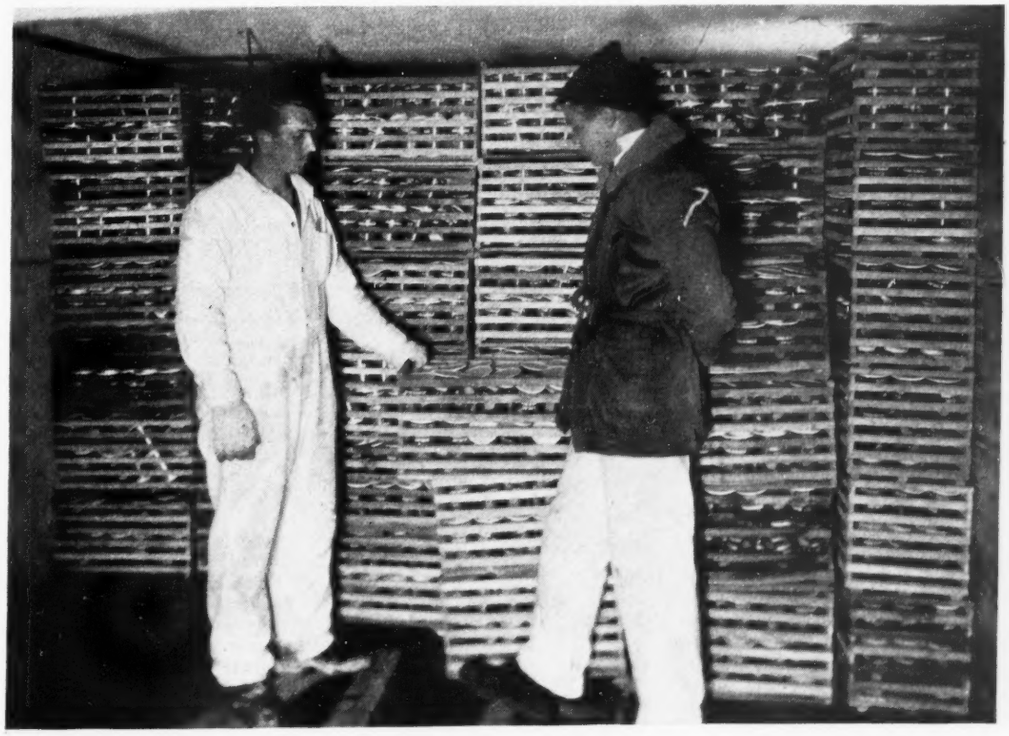

Fig. 4 — Hardening room of National Juice Corporation. Paper cups containing pre-frozen juice of the consistency of sherbet are stacked in onion crates to give free air passage. A blast of air at —10 deg. F. does the final hardening

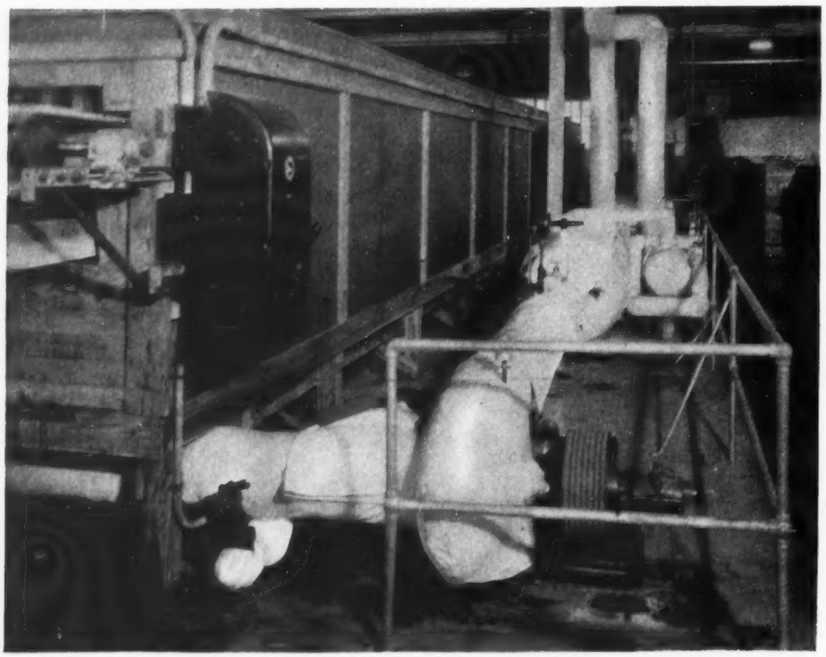

Fig. 5—"Inver" freezer and its individual brine cooler at Borden's; view near intake end

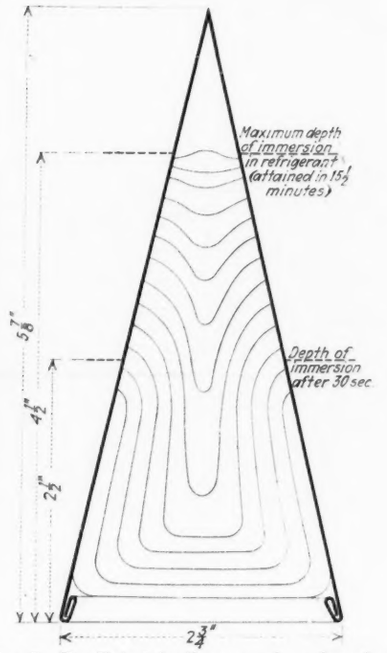

Fig. 7—Predicted isotherms when freezing in Sealcones by the inverted method—freezing from the bottom upward. Compare with Fig. 8

Fig. 8—Showing the progress of freezing in the "Inver" system. The block on the right had been in the freezer about 12 minutes. Notice the bulge on the top of the completely frozen block on the left

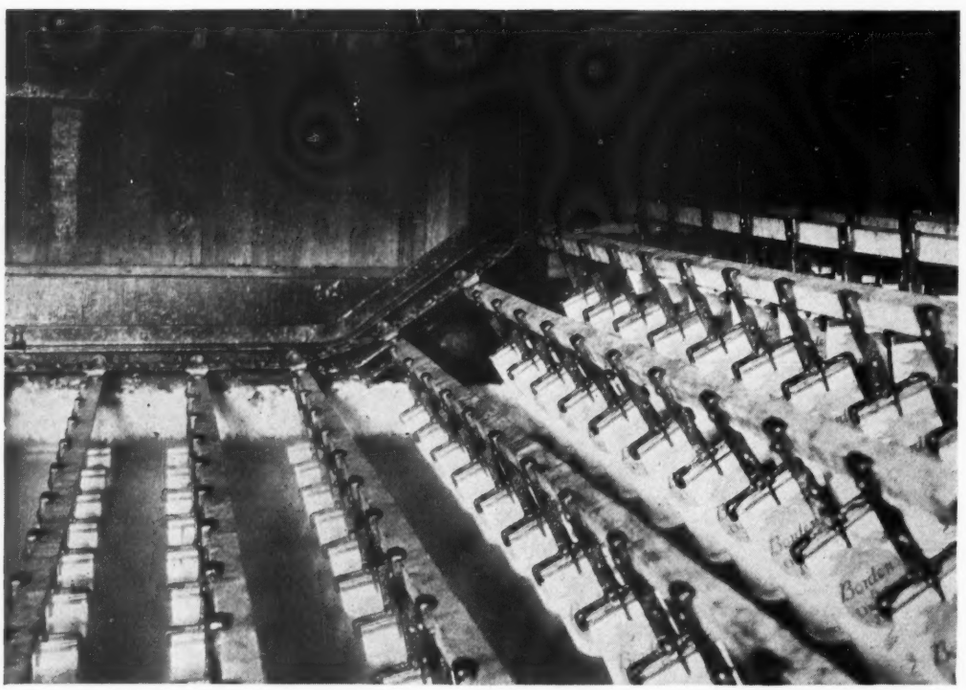

Fig. 6—Interior of "Inver" freezer near the discharge, showing how the containers are hooked onto the conveyor. Containers move to the right against the brine flow

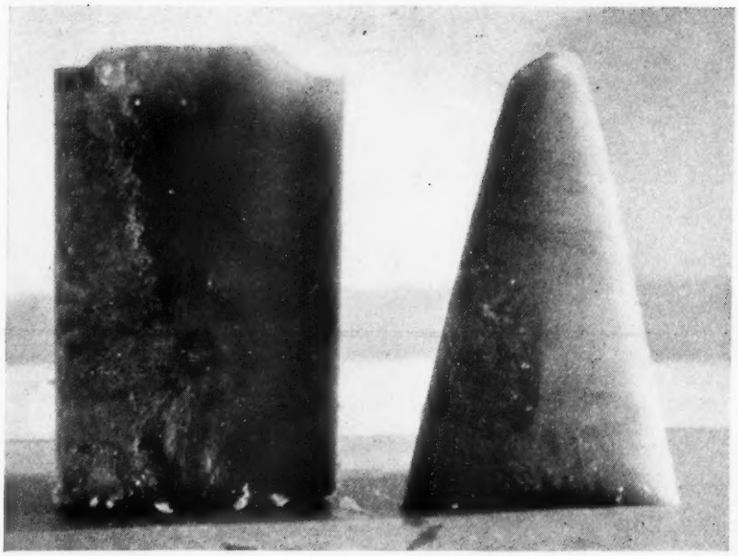

Fig. 9—Orange juice frozen in a Sealcone and sliced in two, illuminated by transmitted light

paper shipping containers and stored at about 10 deg. F.

Florida Orange Juice Corporation

The system used by the Florida Orange Juice Corporation in freezing orange juice at Winter Haven, Fla., was developed by A. B. Hale, consulting engineer of the Florida Citrus Exchange, Tampa, Fla. At this plant, the strained juice is filled directly from automatic juice machines into 1-gal. cans, which are then vacuum sealed and conveyed into a brine tank. A roller conveyor on the bottom of the tank is employed. The capacity of the freezer is 750 cans. The cans move through the circulating brine tank and are taken out in six hours. The temperature of the brine is 0 to —2 deg. F. The cans are then dipped in water, sealed in shipping cartons, and placed in a storage room having a capacity of three cars. This room is held between 0 and —10 deg. F.

Tampa Union Terminal

Orange juice is frozen also by the Tampa Union Terminal, Inc., which began operations last year and probably is the pioneer in this industry in Florida. Here the strained juice is filled into No. 10 cans, and frozen in a cold room by means of an air blast at about —10 deg. F. (Three concerns are operating in this building.)

Tom Huston to Enter the Field

Equipment is now being installed at the plant of Tom Huston Frozen Foods Company, Montezuma, Ga., by the Gay Engineering Company for the production of frozen orange juice. The plant is scheduled for completion in time for the late Valencia oranges.

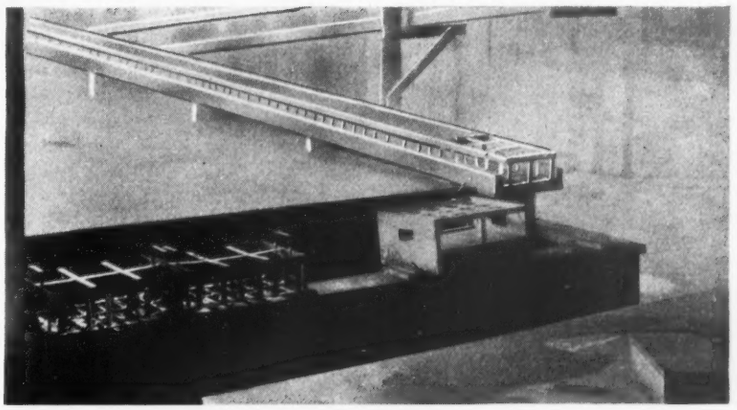

Fig. 10—Hale freezing system of the Florida Orange Juice Corporation at Winter Haven. Containers are placed in the metal baskets and slide down an incline to a conveyor submerged in the refrigerating brine

Fig. 11—The Hale freezer is intermittently operated. After it is filled with 750 gallon cans, the conveyor is stopped for 2½ to 4 hours until freezing is accomplished

Quick-Freezing for Non-Retail Distribution

By F. X. BURKE
Quick-Freeze Corporation
New York City

THE emphasis placed on retail distribution of quick-frozen foods in small packages has, for one reason or another, obscured the fact that bulk distribution of such products to other food manufacturers and the wholesale-institutional trade offers immediate profit possibilities unobstructed by display-case difficulties, consumer education problems, and similar drawbacks.

If poultry "splits" (halves), for example, were made available to the restaurant chef fully prepared for the oven, devoid of any appreciable deterioration—in fact, higher in quality than obtainable in any other form—it would require very little "education" to lead to their use. The steadily rising consumer demand in outlets of this kind for frozen products in their crudest and least satisfactory form (unsatisfactorily packaged products slow-frozen in bulk) is ample testimony of this fact. Moreover, there is an increasing inter-season demand for such perishables as vegetables, fruits, dairy products, and eggs for use in the manufacture of ice cream, bakery products, beverages, soups, and the like.

A well-nigh universal failure to recognize the wide difference between bulk freezing and bulk distribution is perhaps the crux of the whole matter. The mere fact that frozen eggs, for example, can be best distributed in 30-lb. pails does not mean that they should be frozen in 30-lb. units. In fact, if they be quick-frozen in 1½ in. circular slabs which are assembled in the 30-lb. pail when frozen, there will be a gain not only in quality but in real refrigerating efficiency.

Let us consider poultry once more. Because bulk shipments of whole poultry in boxes of twelve or more has become the ordinary practice, the custom has been to freeze the product in this same unit. In a good sharp freezer operating at 0 deg. F., the poultry will take from 30 to 48 hours to freeze. Obviously, this is not quick-freezing, and the deterioration in quality from the slow freezing usually is augmented by desiccation and by internal changes in the walls of the intestinal cavity after defrosting. If, on the other hand, the poultry is drawn before freezing, desiccation and cavity spoilage is an even greater factor; in fact, certain states prohibit the sale of frozen drawn poultry.

Quick-freezing of split poultry, on the other hand, not only permits superior cleaning and inspection but saves space in transportation, permits better utilization of byproducts at the packing plant, and saves labor for the recipient. By far the greater part of the restaurant trade serves poultry prepared in this fashion in the kitchen as it is, and the plant could do it more efficiently.

The two halves of split broilers, running 18 lb. per dozen, can be pressed into a rectangular mold 6½x3½x1¾ in., one split surface facing the bottom of the mold and one facing the top. Group molds containing a greater number are equally as satisfactory, provided one important fact be kept in mind: *The mold must be narrow in one dimension.*

Assume, for example, that when frozen in such a rectangular mold 3 in. thick in contact with brine, a product under a given set of freezing conditions will freeze in 3 hours and 20 minutes. If the thickness across the dimension be increased to 6 in., the freezing time increases to approximately 13 hours, 20 minutes. If, on the other hand, we reduce the original thickness to 1½ in., the time for freezing drops to 50 minutes and we come into the zone of really quick-frozen products.

This wide range of freezing times, following the law which states that freezing time varies directly as the square of thickness, when analyzed in the light of some of the package dimensions which are chosen by quick-freezing aspirants, will indicate the source of difficulty being encountered.

The economy which, along with the improvement in the quality of the final product, accompanies the reduction of the thickness being frozen is not at first easily seen. A given quick-freezing machine holding, say, 1,000 lb. of products at a time, with a thickness to be frozen of 3 in. and a freezing time of 3 hours, 20 minutes, will have a capacity of 300 lb. per hour. By changing the thickness of the product to 1½ in., the amount in the machine at any one time is cut to one-half, or 500 lb. However, since the freezing time has been reduced to one-fourth (or to 50 minutes), the capacity is increased to 600 lb. per hour; or, in other words, doubled.

A continuous conveyor-type quick-freezer using brine as the cooling medium and handling the product in reduced thicknesses in a double-contact freezing container or mold has been found to accomplish most favorable results in that direction. With such a machine there are no peaks in the refrigerating load and the temperature required to accomplish rapid freezing is high in comparison to those often employed.

In mentioning the double-contact freezing container or mold, it should be emphasized that double contact is vital to a quick-freezing machine. It has an effect which approaches that of cutting the thickness to be frozen in half.

The investment required in compressors, motors, condensers, brine coolers, circulating pumps and miscellaneous equipment for delivering the required refrigerating effect to the quick-freezer will be governed by (1) the lowness of temperature required, (2) the completeness of the freezing [the percentage of moisture frozen out of the product], (3) the temperature of the product upon entering the machine, (4) the latent heat and specific heats of the product, (5) the peak duty in pounds per hour to be frozen [not the average load], (6) the choice of refrigerant [ammonia or carbon dioxide], (7) the temperature and nature of condenser cooling agent available, (8) the refrigerating losses within the complete system, but principally in the quick-freezing cycle, and (9) numerous other items which, with a good equipment layout, usually are much less important.

For a given product and a given original temperature and final temperature, the largest items are the lowness of temperature necessary to give the desired speed of freezing to retain high quality in the product and the peak load to be frozen in pounds per hour.

To keep these two items controlled to a degree to give the lowest equipment investment with safety it is evident that every means should be employed to get the speed of freezing without resorting to extremely low temperatures, and to secure the production capacity desired without throwing peak shock loads upon the primary refrigerating system.

With an effective quick-freezing machine which takes advantage of the principles indicated above, the costs of packing can be reduced far below those now possible in sharp-freezers. Since quick-freezing combines the benefits of lower equipment cost, reduced operating expense, and greatly improved quality, it seems certain that many of the "cold-pack" and slow-frozen products for the wholesale-institutional trade now emerging from "sharp-freezers" will soon be quickly frozen and sold on a higher quality basis. Among such for which there appear to be great possibilities are picked shrimp, shucked oysters, sausage meat, green bacon and hams, edible offal, shelled lima beans, prepared green and wax beans, peas, asparagus, and a number of fruits and fruit juices now being prepared by "cold-pack" for the institutional trade.

Where Quick-Frozen Vegetables Stand Today

By CLARENCE BIRDSEYE

Vice-President, General Seafoods Corporation, Gloucester, Mass.

WE hear a great deal about "quick-freezing systems." To my way of thinking, that phrase, as usually interpreted, is a misnomer. The actual method of freezing is but one subdivision of a system which must include correct varieties and qualities of raw materials, suitable location of plants, efficient elimination of waste, sufficient packaging, successful long-term cold storage, safe transportation and sub-warehousing, efficient store delivery, and foolproof retail handling.

Success in production and distribution of frozen vegetables depends first of all upon the variety frozen. All canning varieties are not suitable for quick-freezing. In fact, truck garden varieties usually are more desirable for this purpose. In the case of peas, we have found that the Gradus and Tall Telephone are very desirable as commercial packs in Oregon. Other varieties, such as Pioneer, Little Marvel, and Gradus, packed in New England have given more or less success when frozen unblanched, if the storage period is not extended over four months and the temperature of the storage maintained at —20 deg. F. These same varieties have not been experimented with in the blanched condition.

The Gradus and Tall Telephone varieties were blanched before freezing in the commercial pack in Oregon. Experimental unblanched packs suffered detrimental changes in flavor after four months storage at 0 deg. F. Such canning varieties as Telegraph, Surprise, Horsford, and Alaska have not given much promise. Some varieties of peas will retain their normal structure if they are frozen without being blanched, but will break down badly if blanched; with other varieties just the reverse is true.

I have noted with interest and some amusement the publicity given to a "new British development" which contemplates a short cooking to destroy enzymic action previous to freezing. It is an excellent idea—or we would not have been blanching the products that it benefits for the last couple of years!

We have found that Broadleaf spinach packed in Oregon has been very successful. The Princess Juliana packed in Gloucester also was very good, but no extensive variety study with spinach has been carried on in this laboratory.

It seems highly probable that the same varieties of both fruits and vegetables grown in different parts of the country will have varying values for quick-freezing. It is even possible for the same variety in the same locality to vary from season to season; for instance, the same variety of strawberries packed in wet and dry seasons may behave differently.

The problems of proper maturity also require specific experimentation on each

Clarence Birdseye

class and variety of vegetable. Generally speaking, mature peas are less damaged structurally by freezing than is the case with immature peas. Corn apparently undergoes less enzymic change during a storage if packed when it is comparatively immature. The stems of asparagus toughen so quickly after the product is cut that it must be frozen within a very few hours. Inasmuch as frozen products are not subjected to the prolonged cooking (which usually means tendering or softening) necessary in canning, their maturity should, as a rule, be comparable to that required if they were to be eaten fresh from the garden.

Let me emphasize the fact that necessity for considering chemical structure, enzymic content, water content, maturity, and several other factors in producing fruits and vegetables of high quality does not end with the freezing operation. During the past year it has become increasingly evident that frozen plant products are much more difficult to cold-store and distribute than frozen meats or sea foods. This is largely because enzymic action takes place more rapidly and at lower temperature. A carload of frozen fish fillets may be shipped across the country without damage if the product temperature remains at 20 or 22 deg. F. Under similar circumstances a carload of frozen peas would be adversely affected by enzymic action. For long-distance shipments of vegetables, we have found it necessary to employ temperatures close to 0 deg. F.

Of course, this is of little avail if the care does not continue down through the distribution system. In one instance, an excellent vegetable product was successfully frozen and shipped across the continent, but was ruined by unsatisfactory temperatures in the regional warehouse where it was held for a comparatively short time. Another source of trouble has been crude refrigeration facilities in retail outlets.

In the face of the difficulties that I have pointed out, there is likely to arise a question as to whether the fundamental idea of preservation of vegetables by quick-freezing is worthwhile.

Generally speaking, I should say that freezing in cartons is cheaper than canning, but subsequent storage, transportation, and merchandising costs are higher. How much higher the latter factors will be indeterminate, of course, depending upon the facilities available as well as the characteristics of the particular product.

No one with economic common sense would contend that development of vegetable freezing will put the canners out of business. On the other hand, competition of canned products cannot prevent the development of quick-freezing in certain broad fields for which it is particularly fitted.

As canned fruits and vegetables practically never taste the same as the fresh product, quick-frozen perishables of high quality compete with fresh products rather than with canned. Costs of packing and distributing frozen foods should, therefore, be compared with those for fresh products. I think that there can be no doubt that the loss-free, compactly packaged, quick-frozen products can be produced and distributed on a large scale at a lower cost than the corresponding fresh product, particularly where "out-of-season" demands are to be met. In certain localities, this is already a fact. Moreover, for products which, like frozen spinach, offer the consumer added convenience in the form of cleaning and preparation, prices above those of the fresh product have proved economically justifiable.

We have so successfully packaged, frozen, stored, transported, and merchandised green peas, lima beans, and spinach that we are planning large commercial packs in Oregon this summer. Moreover, our experiments with asparagus, cut corn, corn on the cob, string beans, wax beans, and several other plant products have been successful enough to justify small commercial packs. Altogether, over 250 tons of packaged quick-frozen vegetables will be produced at the Oregon plant during the coming season.

Cold-Packed Barreled Fruit In 1930

By ROBERT IRELAND
Terminal Ice & Cold Storage Company
Portland, Ore.

EVERY perishable product has a cold-storage value; some will stand more cold than others, just as some will stand more heat than others. It is therefore necessary that the cold storage warehouse man fully understand the methods of applying cold to keep any product in the finest marketable condition. Just to keep the product frozen or cool does not in any sense mean that it will be in the finest possible shape when it comes out of storage; far from it, unless it has been kept at the temperature best adapted for that commodity. Proper relative humidity and even temperature control likewise are necessary.

In the early part of 1930 the writer advanced the idea that strawberries packed in barrels put up with 2x1 or 3x1 sugar, which means two or three parts of berries to one part of sugar, should be rolled every two hours during the process of freezing, in order to cool the berries more evenly and to keep the surface of the fruit well in contact with the sugar syrup. The close contact with the syrup would prevent oxidation, and a cold-cure while in this condition over a period of 90 days should greatly improve the final product.

This system had a far-reaching effect, and the fruit greatly improved in color, texture, and flavor. The tendency has always been for berries in barrels to float up out of the syrup while freezing, forming a solid frozen pulpy mass and draining the fruit of its juice and sugar syrup. This kind of a pack is badly discolored, hard to thaw out, and has a gassy appearance and oxidized odor. In cold-curing, the berries stay covered with syrup and do not buoy up, but become heavy with the syrup and are held in suspension. Strawberries handled in this way have an even sweetness and do not have a gassy appearance or oxidized odor. The packing industry may expect greater things from this new method of handling barreled sugared strawberries. Since it is expensive, many storage houses have not even tried to work out the system, while others are storing the fruit at such low rates of storage that they are not able to carry the expense of cost of extra labor. Then, again, there are those that go on the theory that freezing alone is all that is necessary.

However, it must not be assumed, as a great many have assumed, that rolling the barrels over a few times to distribute the sugar syrup evenly and thus prevent discoloration, is all this method requires; this is only the beginning of the improvement. The foundation of our success rests upon reducing the time required to get the heat out of the fruit, and upon holding it at the proper curing temperature in order to maintain the qualities of color, flavor, and texture necessary to make the finest finished product. The heat must be extracted as quickly as possible without hard-freezing the fruit, so as not to rupture the cells. This can be accomplished only by applying sufficient cold at a very low temperature to remove the heat units originally present in fruit and sugar, and to reduce the temperature throughout the whole barrel of fruit in 48 to 54 hours to 18 deg. F., where it should be held for cold-curing.

It is not the intent of this process to be a cure-all for many things that go to injure the strawberry or cold-pack business, and a watchful eye must at all times be kept over the picking and packing of the fruit. County agents are doing good work among the growers in producing good quality fruit and I quote here a few of the most important factors that are essential to producing the finest finished product:

1. The berries must be clean and good sound fruit.
2. Sunburnt, over-ripe, moldy or half-ripe fruit must be carefully graded out.
3. Berries must be washed and graded to size by special machinery adapted for this purpose.
4. Even distribution of the sugar with the fruit is essential.
5. All fruit to be cold-processed should be in storage within two hours after picking. Fruit stored immediately after picking will keep longer and has a firmer body and better flavor.
6. Freezing of all fruit should be under the supervision of a practical cold-storage man who understands how to cold-store fruit to maintain its quality factors.

When strawberries are packed in barrels with proportions of 2 lb. of berries to 1 lb. of sugar or 3 lb. of berries to 1 lb. of sugar and properly frozen and cold-cured, they will have these characteristics:

Color.....	Bright and practically free from discoloration.
Texture....	Firm.
Flavor.....	Fresh, like fresh strawberry aroma.
Appearance..	Sugar syrup distributed uniformly throughout the mass of fruit. The fruit stays down in the syrup free from discoloration.
Thawing....	Once the fruit is cold-cured it will require very little thawing. By tempering out at a temperature of 28 to 30 deg. F. for a couple of days with the barrels on their sides the fruit will be ready for use.

The success of the whole cold-packed strawberry business rests upon the method of freezing, handling, and holding the fruit at a temperature that will maintain the fruit in its natural condition as far as it is possible to have it do so, and not on the simple act of freezing to prevent fermentation.

Cold-processing of any fruit has become a science in every sense of the word, and it is necessary for the cold storage man to comply with the demands. New ideas are coming forth daily. We may go along for a time thinking we have things going just right, when suddenly there bursts forth some unanticipated new idea. Slowly and reluctantly we take to it. If it is a success we will all want it, and it is the business of the cold-storage man, as well as others, to keep pace in the line of progress.

Strawberries, for example, should never be cold-packed without sugar, as they are made up of little cells, the tissues of which break down by freezing. When thawed, the juice runs out, leaving a pulpy, oxidized, poor quality fruit, while strawberries packed with sugar and cold-cured can be handled without serious changes taking place. In short, the long-continued cold, when applied in the proper way, does the work efficiently and without destruction to the fruit cells.

Our experiment the past year has also brought out more forcefully than ever the importance of defrosting all fruit in storage in the original container without exposing the fruit to the air. Variation in temperature causes fluctuations in percentage relative humidity. At near freezing temperature the range in degrees of temperature change that will cause saturation or dew formation, is narrow. If the perishable product is at a lower temperature than that of the air, excess moisture in the air will quickly deposit on the exterior of the fruit. Discoloration and increased moisture in the fruit are the result. Such a treatment is severe and reduces the vitality and appearance of the product. It is, therefore, very essential to exclude the air while defrosting. Keep the barrel on its side and roll it occasionally to keep the sugar and syrup well around the fruit.

The freezing of fruit in barrels is not new to the cold-storage man. However, by careful study each year of this cold-pack freezing and handling in storage, we assemble a lot of new ideas and more improved methods. We cannot expect the packer or the buyer to solve our cold-storage problems for us but, with their co-operation for improved quality fruit, it is the duty of every refrigerating man to do his part in order to bring about better and more uniform systems for the benefit of the cold-pack fruit industry so that it may grow to be a distinctive product of merit.

Thawing Public Prejudice Through Master Merchandising

Recent experiences in the distribution and marketing of quick-frozen foods

By O. FRED ROST
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McGraw-Hill Publishing Company

Refrigerated showcase made by Grand Rapids Store Equipment Corporation, designed to hold frozen foods at zero temperature

EXPERIMENTS in the distribution and marketing of quick-frozen products conducted by several companies in various fields have developed much important knowledge on the subject. While some gratifying successes have been achieved, there are other cases on record where for specific reasons results were unsatisfactory.

The most definite benefit recorded is the fact that there no longer can be any doubt in the mind of those interested in distributing quick-frozen foods that any degree of success can be achieved or a profitable volume of sales developed only when retail food merchants are equipped for proper storage and display. It has been conclusively demonstrated that ordinary ice-boxes cannot and do not keep quick-frozen products in prime condition for a sufficiently long period of time to permit the most economical merchandising practices. Consequently, any attempt to establish retail outlets for quick-frozen products in stores that are not equipped with low-temperature refrigerators will simply result in dissatisfaction on the part of the consumer, and retard rather than promote progress.

Therefore, the producers of quick-frozen products are at present addressing themselves almost as seriously to solving the question of developing properly equipped retail outlets as in the past they endeavored to improve their products, the packages, and ways and means of gaining consumer acceptance.

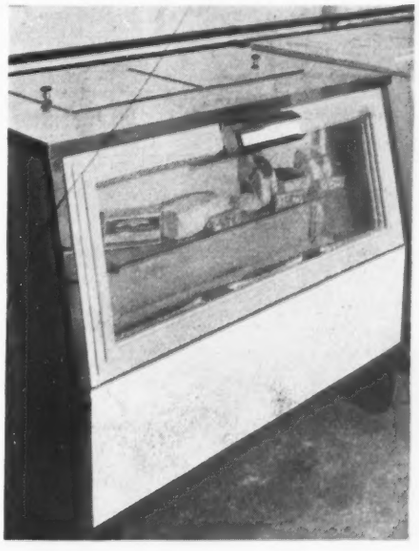
The most important experiments in the marketing of quick-frozen products have been carried on by the General Foods Corporation through its Frozen Foods Division. Eighteen stores located in Springfield, Mass., were equipped with suitable low-temperature display and storage cabinets. Various quick-frozen food products were advertised early in March, 1930, and since then records have been kept of the results.

The outstanding fact developed was that *when the public once becomes acquainted with the advantages of quick-frozen foods it continues buying them.* At Springfield, 80 per cent of the consumers who bought quick-frozen foods during the first week of the test have become regular customers and are purchasing quick-frozen foods continuously. It has also been found that after consumers know the products they no longer are inclined to question the price. Convenience and cleanliness of the packages and later the ease with which quick-frozen foods are prepared for the table have greatly contributed to their popularity wherever they are being properly merchandised.

A careful check-up of results of the experiment carried on at Springfield convinced General Foods Corporation that under proper conditions quick-frozen foods can be marketed successfully and at a profit. Supporting this conviction, it has extended retail operations until now over 300 retail stores located in the New England States regularly carry quick-frozen foods as a stock item. Distribution to retailers in other Eastern states is now under way and will be extended just as rapidly as production capacities can be provided to take care of the increasing demand.

The original eighteen test stores at Springfield, as well as other stores now retailing General Foods Corporation's quick-frozen products, will eventually handle the complete line, which now consists of over 80 items. However, the company's quick-frozen fish, fish steaks, etc., have obtained much wider distribution, and are now being regularly marketed in twenty odd states. It is particularly interesting that it is no longer found essential that quick-frozen fish travel to the point of dis-

Smaller showcase of same make as that in Fig. 1, differing by having top opening in place of rear opening



One concern packing frozen meats uses all-cellophane wrapping with this type of parchment label to identify goods

tribution in low-temperature freight cars. Special shipping cases are now employed providing heavy insulation through several layers of corrugated cardboard. These permit but a gradual escape of the low temperatures at which the contents are packed. Shipments of fish in such cartons, traveling in non-refrigerated cars, have reached points in Arizona in satisfactory condition.

For the purpose of eliminating the final obstacle to getting the broadest possible distribution of quick-frozen products, General Foods Corporation just recently completed arrangements with the Commercial Credit Company, Baltimore, Md., for the financing of retailers' purchases of low-temperature display and storage cabinets. After the design and mechanical equipment of low-temperature cabinets have been approved by the technical department of General Foods Corporation, the Commercial Credit Company will finance the purchase of such cabinets by established retailers on a basis where for a nominal charge they will pay for them by monthly instalments.

In view of the fact that the Springfield experiment has conclusively proved the salability of quick-frozen products when a complete line of meat, fruits, fish, and vegetables is offered, it is expected that the easy terms for purchasing equipment provided in this new arrangement will greatly increase the number of retailers offering quick-frozen products to the public.

The most significant development, and one that particularly demonstrates General Foods Corporation's confidence in the future of the quick-frozen foods industry, is the announcement just made public as the present issue of *Food Industries* goes to press. For very practical and important reasons General Foods Corporation has joined hands with Standard Oil of California in forming Pacific Frosted Foods, Inc., which under joint control will undertake the development of the quick-frozen foods market in the far western and Pacific Coast territory.

The range of frozen foods available is increasing. Here is a typical package of frozen steak

The new company will operate under license from General Foods Corporation to use the Birdseye quick-freezing process in the states of Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington, and Wyoming; also in western Mexico, Alaska, and Hawaii.

The far-reaching effects that this union of two important interests foreshadows cannot at this time be properly estimated. General Foods Corporation has its patents, its wealth of scientific and engineering data accumulated during seven years of production and marketing of quick-frozen foods. On the other hand, Standard Oil of California is in excellent position to contribute some of the essential factors that will make for the rapid organization of production facilities on the Pacific Coast. It controls the Pacific Public Service Company, which in turn owns the California Consumers Company. The latter is the important unit in the new alignment in that it now owns nine ice-manufacturing plants and four cold-storage plants. It is expected to install equipment for quick-freezing just as rapidly as is feasible, as it is desired to get into production at the earliest possible moment.

That the formation of Pacific Frosted Foods, Inc., is one of the most important forward steps that have been taken in the quick-frozen foods field during the last year is indicated by the schedule of development it is understood this company is to undertake. Just as soon as the necessary supply can be arranged, retail sales outlets will be established in independent chain food and other types of stores. It is hoped to have at least 300 stores on the list within a year. Production facilities will be developed as the demand for the product increases and it is anticipated that within five years from 10,000 to 12,000 retail outlets on the Pacific Coast will regularly stock quick-frozen foods.

Just what this will mean in the way of sales volume can be readily estimated from the figures developed through the Springfield experiment. There the eighteen stores handling a total of perhaps 30 different items of quick-frozen foods have shown average weekly sales of over $200. The present line of quick-frozen food products already includes over 80 items and is still being expanded. Obviously there is fair justification for the estimate made by some authorities in the field to the effect that within five years the quick-frozen food industry will count its total volume in billions of dollars.

Second in importance only to General Foods Corporation's Springfield experiment are the results of a test campaign conducted by Atlantic Coast Fisheries Company at Syracuse, N. Y. This experiment differs from the one at Springfield in that it provided for a more intensive sales attack and involved city-wide distribution rather than merely a limited number of stores. The study in Syracuse demonstrated that small retailers are entirely unsatisfactory as outlets for quick-frozen fish. Of 73 retailers handling Nordic fish steaks at the end of November, 1930, only 4 per cent were small dealers, 63 per cent of medium size, and 33 per cent large dealers. The most satisfactory cooperation was obtained from independent stores with combination meat and grocery departments. This class represented 66 per cent of the total.

Frozen fish such as this was one of the first frozen foods to be successfully marketed

The consumer check-up made by Atlantic Coast Fisheries Company is particularly significant. Of 139 consumer residents in various parts of Syracuse, 76 per cent reported that they had repeated their purchase of quick-frozen fish. It will be noted that this percentage nearly parallels the 80 per cent repeat patronage reported by General Foods. Of those repeating, 35 per cent had bought Nordic fish steaks at least once a week, 23 per cent once in two weeks, and 42 per cent less often. Of the 139 consumers interviewed, 119 stated particularly that they bought quick-frozen fish steaks because they liked the flavor; 55 also commented on the convenience and ease with which fish steaks are prepared for the table; 17 particularly liked the idea of buying fish in sanitary packages.

The experiment developed one important criticism from retailers in that they felt that a larger margin of profit should be provided for them, due to the greater expense involved in handling quick-frozen foods and the possibility of losses from spoilage. Furthermore, dealers were found to be

rather indifferent toward promoting the sale of quick-frozen fish, but it is thought that if a more complete line of quick-frozen products had been involved, proportionately better results would have been accomplished.

That variety of products is essential to the successful marketing of quick-frozen foods is indicated by the experience of Indianapolis Abattoir Corporation. This company employs the Kolbe process in quick-freezing a variety of meats. A recent price list shows 38 different cuts of meats, etc., all sold under the "Sally Lee" brand. Cellophane wrapping is employed so as to permit complete inspection by the prospective purchaser, and this fact is said to have contributed materially to the popularity of the "Sally Lee" line.

The Indianapolis Abattoir Corporation provides its dealers with low-temperature storage boxes, for which the dealer pays a small rental. This plan was adopted after it was found practically impossible to interest retailers in purchasing their own equipment. To obtain widest possible distribution of its quick-frozen meats this company carries two different grades. The quality of the standard grade compares in every respect with the grade of meats sold in the average butcher shop, while the prices are kept either equal or somewhat lower than average prices for the same quality. In its premier brand this company offers especially selected cuts and sells them at prices approximately 20 per cent higher than those of the standard grade.

Just how important it is for the industry to solve the question of low-temperature cabinets for retailers is indicated by the experience of a company that entered the industry in 1930 and packed over 600,000 lb. of fresh Georgia peaches. These were quick-frozen and offered in two sizes of waxed-paper containers; the one size contained 4 oz. and was to be retailed for 10c. and the other contained 1 lb. net. The company planned to distribute these quick-frozen peaches through drug and grocery stores. It was presumed that druggists or any stores having electrically operated cabinets for ice cream could readily store these peaches until sold.

However, ice cream manufacturers, who in most cases owned those storage cabinets, objected to having their cabinets used for storing what they considered a competing product. Few grocery stores were found suitably equipped for carrying quick-frozen peaches in stock and so that company has had great difficulty in obtaining retail distribution.

Recently a large quantity of quick-frozen peaches was retailed by a large candy chain at prices indicating that the manufacturer is endeavoring to unload his 1930 crop at almost any price, the full 1-lb. container being retailed at 27 cents.

Obviously, producers of a single quick-frozen product, or only two or three items, must expect to encounter serious difficulty in obtaining retail distribution until a sufficient number of retailers have installed low-temperature cabinets on their own account to enable them to be independent as to which lines of quick-frozen products they handle.

That manufacturers of refrigeration equipment have addressed themselves to the task of providing suitable equipment at reasonable prices is indicated by recent developments. Already General Electric Company, Frigidaire Corporation, Servel, Kelvinator, and several other important manufacturers of domestic refrigerating equipment have added low-temperature cabinets to their line. Designs vary greatly, but at present the most popular cases provide space for display purposes and beneath that storage space for a stock of quick-frozen products.

Orange juice is a new addition to the list of quick-frozen foods now being marketed. National Dairy Products Corporation has formed a subsidiary, the National Juice Corporation, and established an extracting plant at Tampa, Fla. To prevent oxidation and deterioration of flavor the juice is quick-frozen for 3 minutes under vacuum and then in semi-frozen condition packed in the containers, after which it is kept in a hardening room at a temperature of 10 deg. below zero.

Retail distribution of quick frozen orange juice was commenced late in March in New York City, New Haven, Buffalo, Erie, Cleveland, and Pittsburgh. However, no figures are available at this time to indicate just how this experiment is progressing.

Frozen fruits such as strawberries and raspberries have recently achieved consumer popularity in some districts

The inner cellophane wrapping of this package of frozen chops serves to keep the food in sanitary condition

Large cuts of frozen meat may be wrapped in cellophane and label attached, instead of being placed in a box

Refrigerated Cabinets Improved for Frozen Foods

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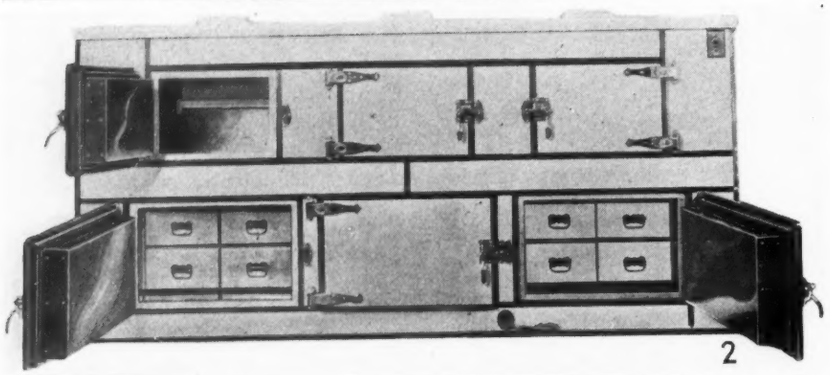

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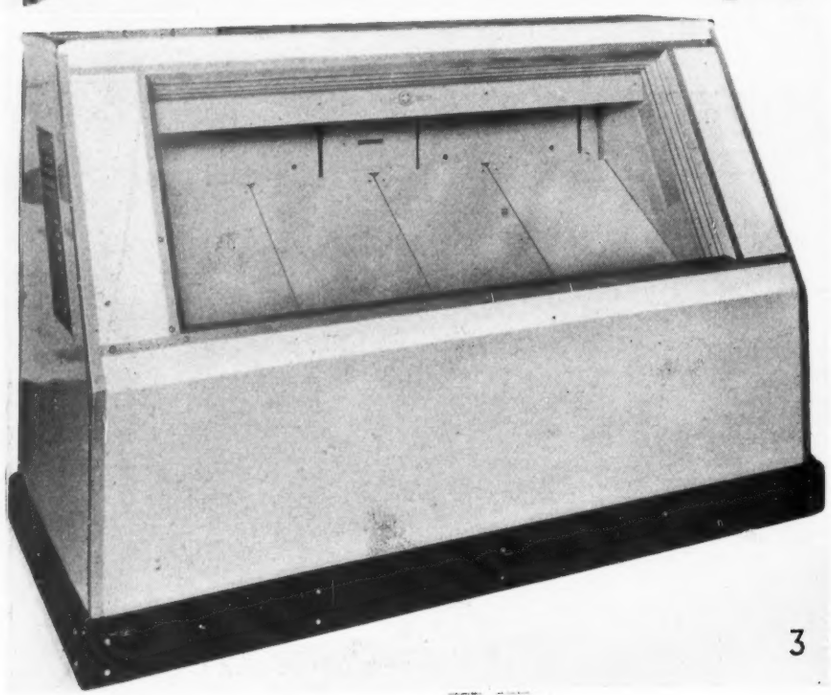

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ALTHOUGH surprising changes have been made in the construction of storage and display cases during the past year, these cases are still in an evolutionary stage of development. Investigators in the field of merchandising frozen and refrigerated foods are stimulating manufacturers of refrigerating equipment to make available means of supplying consumers with perishable foods in as wholesome and appetizing condition as is possible to maintain from source of production to ultimate consumer.

Equipment shown in this section illustrates the latest developments by manufacturers to make a reality of this merchandising hope and represents what has come to the attention of FOOD INDUSTRIES as being of the very latest type of construction for merchandising perishable foods. It includes the products of those manufacturers who have recently developed equipment of the construction that gives a satisfactory holdover temperature in case of temporary shutdown of a refrigerating unit; that has the display and storage compartments so separated that there is no fogging of glass front when doors of case are opened; that shows no loss of effectiveness due to frosting and defrosting of refrigerating surfaces; that has no circulating air currents to cause desiccation of case contents; and that has temperature control to give and hold the desired range of high and low temperatures in both the display and storage compartments. Although an exhaustive effort has been made to include all cases that have this type of construction, FOOD INDUSTRIES does not presume that this review is all-inclusive.

1. An X-ray view of the 4-ft. glass-topped case built by Grand Rapids Cabinet Company for displaying ice cream products. The airtight, 4-plate glass, display top compartment as well as the storage chamber can be used equally well for other frozen foods. The cabinet is cooled by a Universal Cooler Company unit using methyl chloride in a plate-inclosed coil and is equipped with tight-fitting doors opening on top. Panels separating display and storage compartments prevent air currents from entering the display compartment and fogging the glass when the cabinet doors are opened.

2. Rear view of Oreole 100-in. case, the latest development of Ottenheimer Bros.,

Inc., shows self-closing type insulated doors to both display and storage compartments, baffle separating display and service sections of upper compartment, and drawer construction of end sections of the lower storage portion. The center section is without drawers for storage of bulk packages. The case is fitted with a 4-plate glass front, plate-inclosed cooling coils that are defrosted by occasional scraping or brushing and that maintain a temperature of 10 deg. F. in the display section and 0 deg. F. in the storage portion with a 5 deg. F. variation. Operating in a room 75 deg. F., this case is said to show a current consumption of less than 5 kw.-hr. per 24 hours.

3. Front view of the 6-ft. combination display and storage case manufactured by the Hussmann Refrigerator Company represents one of the plate-inclosed coil type with a 4-plate, airtight glass-front display compartment separated from the service and storage sections to prevent air currents entering the display section and fogging the glass when the self-closing insulated doors are opened for access to the storage stock.

4. Front view of the refrigerated Delamat vending unit, built by Rex Cole, Inc., and refrigerated by a General Electric Company unit for automatic vending of fresh cut meats and other perishable foods. Illustration shows internal construction as well as exterior view of unit. The vending mechanism is operated by a ¼-hp. motor which starts automatically when the proper coin is inserted. Regulated control on the cooling unit, which is driven by a ½-hp. single-phase motor, gives the desired temperature in the cabinet for vending perishable foodstuffs that do not require freezing conditions.

5. Front view of case No. 7007 of the Gibson Refrigerator Company showing display of frozen food products. A ¾-hp. Dole Refrigerating Machine Company unit is said to maintain a temperature of 0 to 4 deg. F. in a room at 90 deg. F. and 98 deg. relative humidity and the machine operating 60 to 65 per cent of the time. It has flat-coil type cooling unit; 4-plate, airtight, glass display front; drawer-type display compartment separated from the service and storage compartments; and self-closing type insulated doors.

6. This rear view of the C. V. Hill & Company, Inc., dry-wall zero case illustrates drawer and baffle partition construction for display service, and storage compartments of latest type cases. Plate-inclosed cooling coils are refrigerated by a Lipman unit and the display compartment is fitted with a 4-plate, airtight, glass front. The display compartment in this 8-ft. case contains 9 sq.ft. of display area, and the service storage area under the display surface and back of the baffle partition amounts to 10 sq.ft. Total capacity of the case is over 800 lb.

7. Front view of Weber Showcase & Fixture Company case shows inclined display surface cooled by plate-inclosed coils and separated from storage compartment. It has 4-plate, airtight, glass display front and self-closing type insulated doors. This 8-ft. case has a service and storage capacity of approximately 30 cu.ft. The display area is approximately 9 sq.ft. and the bottom storage area about 16 sq.ft.

8. A cut-away view of a 2-hole Kelvinator portable ice cream cabinet indicates location of the refrigerating unit and the

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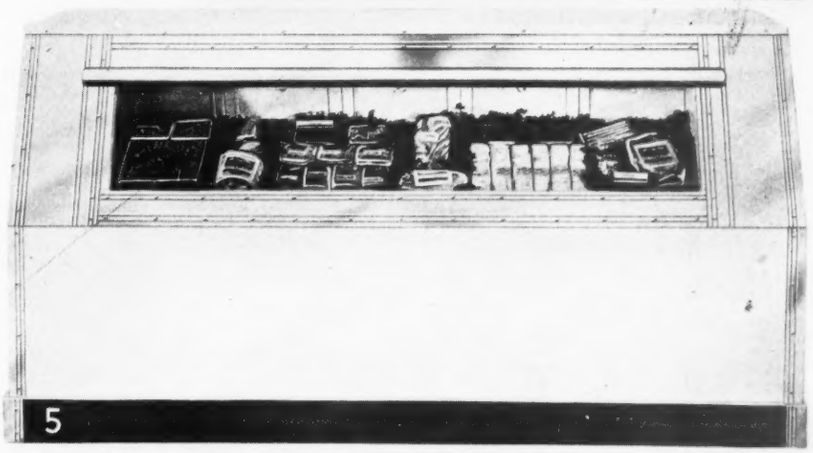
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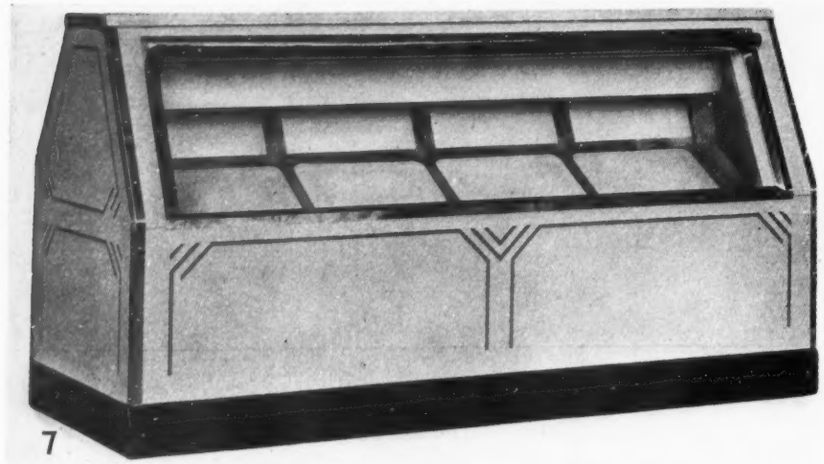

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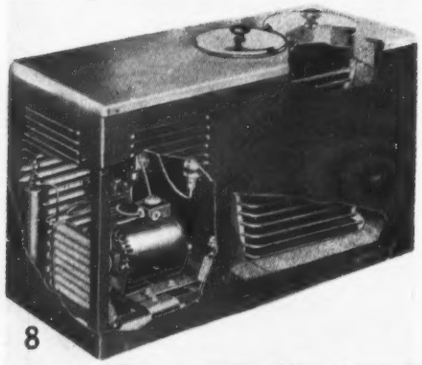

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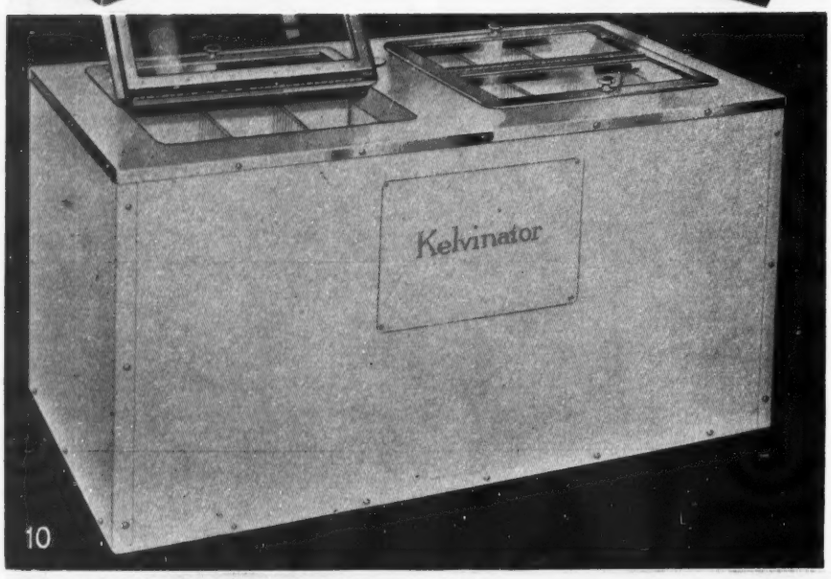
manner of applying refrigeration to the contents of the cabinet. The same type of cabinet, manufactured by the Frigidaire Corporation, has been adopted by Tom Huston Frozen Foods, Inc., for merchandising frozen peaches and the like. The Frigidaire cabinets operate at approximately 10 deg. F. and when subjected to a room temperature of 90 deg. F. consume 2 kw.-hr. of electricity in 24 hours.

9. View of a 4-hole cabinet developed by the Icefin CO_2 Engineering Corporation for merchandising frozen food products, particularly ice cream. When a block of solid CO_2 placed in the middle compartment at the same time that frozen food products are placed in the container compartments, the cabinet, without being pre-cooled, is said to drop at once to 0 deg. F. and to operates on 2 to 3 lb. solid CO_2 per hole per 24 hours in a room averaging 75 deg. F. A fin-type of unit is used to set up conduction currents in the cabinet. A block of solid CO_2 is in contact with the interior of the cabinet on one side only where it forms direct contact on the bottom with the metal lining of the cabinet, which acts as a temperature conductor.

10. This view of a Kelvinator flat-topped, mechanically refrigerated ice cream cabinet illustrates a new type that is being introduced to the market for merchandising frozen foods other than ice cream. Plate-glass, hinged lids open from either side and permit display of contents. A cabinet of this type, built by the Grand Rapids Cabinet Company, is made in 1-, 2-, and 3-compartment styles and has 4 layers of plate glass in the lids, with or without display trays under one lid of each compartment. Each compartment has a package-goods capacity of 25-30 gal. of ice cream.



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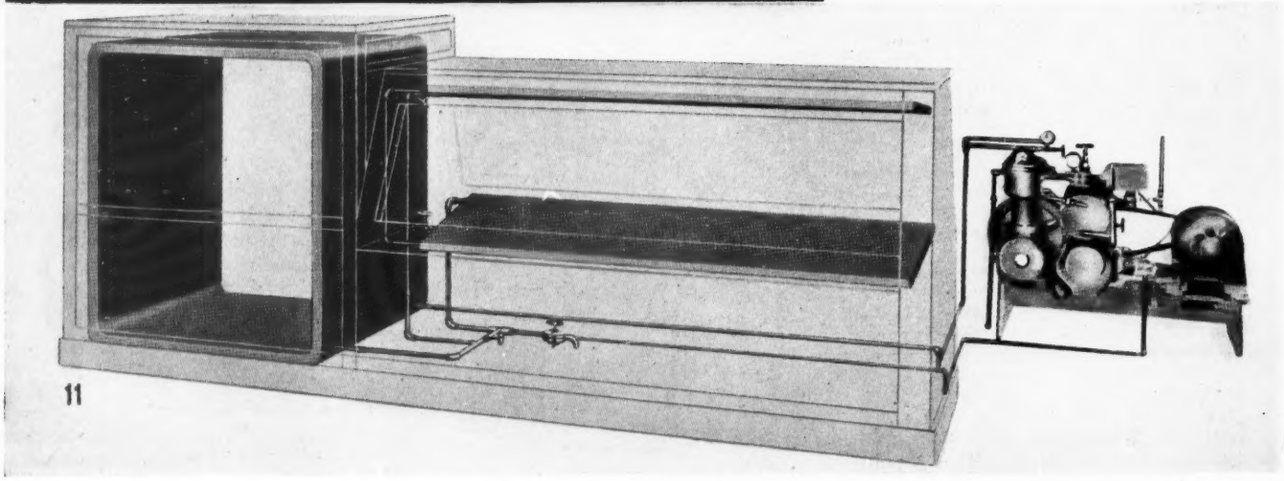
11. A diagrammatic sketch illustrating an installation of a plate-inclosed coil type of refrigerating unit. This particular exhibit characterizes the installation of the Dole Company refrigerating system in a combined 5-ft. storage and 7-ft. display unit which maintains a temperature of 0 to 5 deg. F. in the display case and of 0 to —5 deg. F. in the storage section. This plate type of refrigerating surface reduces frost accumulation on the refrigerating surfaces and eliminates defrosting operations, with their accompanying dangers to frozen foods. The relatively small amount of frost that does accumulate can be quickly removed by a stiff brush or by a blunt, handscraper-like tool.



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Refrigerated Foods Call for Specific Containers

Heavily-paraffined cups are used by one concern for frozen orange-juice containers

RAPID developments in refrigerated and frozen-food products have focused an increasing amount of attention on packing and shipping containers. These shipping aids vary in size from ¼ pint to 50 gal.

When fruits are slow-frozen, bulk containers are used. These are generally lacquered tins and paraffin-lined kegs and barrels made of fir. The barrels and kegs are used in 5-, 10-, 30-, and 50-gal. sizes and the tins run through a range of from 7½ (No. 10 size) to 50 lb. The most popular tin container on the Pacific Coast, where a large percentage of the fruits are frozen, is the 30-lb. lacquered tin with a slip cover.

In the quick-frozen field 1-lb. packages, such as the paraffin impregnated paper cups, moisture-vapor proof lined paper boxes, and lacquered tin cans, are in most common use.

Slip-cover cans of 5, 6, and 10 gal. capacity are used on the Pacific Coast for shipping frozen orange juice in bulk, whereas in Florida consumer-size containers predominate. Sealed paper bottles in ½-pint and paper cups in ½-, 1-, and 2-pint sizes are being used by two large freezing and distributing concerns. One of these companies reports that 6,000,000 each of the three cups will be used from Jan. 1 to June 1 of this year. The pint is the preferred size for a family of four persons. On a less ambitious scale producers are using No. 10 (5/6 gal.) and 1-gal. cans. In some cases these are vacuum packed.

Associated with the use of these small unit paper containers has been the utilization of shipping containers. These cartons not only had to withstand the wear and tear of handling during actual shipping operations, but also resist the damaging effect of moisture and rapid rise in temperature. During freezing operations these cartons are subjected to such low temperatures that condensation of moisture from the air covers their surfaces with considerable water when they are exposed to atmospheric conditions during handling incidental to shipping. The type of carton employed under these conditions is constructed from waterproofed corrugated board and sealing tape. This board and tape contain an unbroken inside film of odorless, polymerized asphalt that, when free from pin holes and other such imperfections, resists penetration of the carton by water and moisture vapor. The construction of these cartons also shows resistance to temperature variations. Grease-proofing involves covering or lining with waxed or paraffined surfaces.

Paraffined Sealcones for frozen orange juice

Merchandising frozen and refrigerated fresh cut meats, fish, and poultry involves a variety and complexity of packages and containers that do not permit generalizations. These packages vary from transparent moisture-proof wrappers for individual cuts to very specially constructed returnable shipping containers for bulk lots of refrigerated fresh cuts.

The use of transparent wrappers has been complicated by gradual desiccation of the product, lack of effective adhesives, and almost exorbitant market price of the transparent material. These handicaps have been minimized by the development of a transparent material that prevents escape of moisture vapor and at the same time has a composition that resists cracking or splitting when subjected to below-zero temperatures. Discovery and development of monomethyl ether of ethylene glycol, a solvent and a cellulose tape type of adhesive

Asphalt-backed sealing tape used on moisture-proof carton

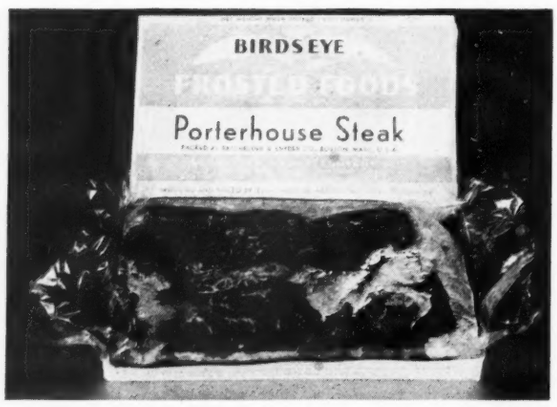
for this moisture-proof material, permits machine processing of units covered with these transparent wrappings. A third type of adhesive encourages the use of a folding box made by stamping box forms out of sheet cardboard, which having at least one side covered with a transparent moisture-vapor proof liner that is both effective in application and economical in quantity of lining material used. Increased commercial demand for this moisture-proof material has resulted in such marked cost reduction that it is replacing paraffined glassine paper as well as waxed parchment for wrapping and lining purposes.

When cardboard boxes are used for packaging frozen fish, meat, fruits, vegetables, and the like they usually are of the folding type that open at the end or on the top. They are made from white, patent coated, manila stock that has been sulphited. The open-end ones are coated with paraffin inside and out and are fitted with an oblong transparent window with round corners. The windows in this box are possible because the fish is frozen before it is packaged. The box with top opening and moisture-vapor proof lining is packed solid before freezing. They are usually 2 in. deep and contain a pound of meat, fish, fruit, or vegetable products. Those containing several individually wrapped fish or meat cuts, family roasts, and the like have greater depth. Each package is labeled to indicate kind and net weight of contents. Both windowed and the top-opened box lend themselves to effective merchandising displays to stimulate consumer interest. Windows in the solid-pack box have not as yet proved commercially feasible because of the destructive action of quick-freezing temperatures on the window forming materials.

Corrugated shipping containers for these foods take on the two forms that utilize solid CO_2 as the refrigerant. In one form the corrugated carton serves merely as a shipping container and has the solid CO_2 compartment situated at either or both ends of the package or in a flue-like compartment extending the length of the container. Usually several layers of corrugated board are used for parcel post or express shipments, whereas only a single layer of double-walled board is necessary for refrigerator car or truck load shipments.

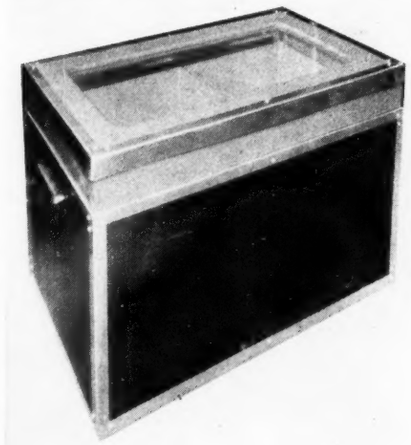
In the other form the corrugated carton also serves as a display package. The solid CO_2 compartment occupies a central cross-section part of the container which is fitted with two cardboard box compartments for the frozen food product and a transparent window display lid. This hinged inner lid shows the contents of the food compartments and by a center panel blocks out the refrigerant compartment. Over this hinged inner lid is the standard double-lap closing top of the corrugated shipping container. These cartons may or may not be made from board and tape containing the asphalt moisture-proofing film. Shipping and storing conditions influence this specification.

Steak is cellophane-wrapped before packing



In transporting perishable food products such as fresh cut meats, under refrigerated conditions from a central producing plant to decentralized marketing centers a combination shipping and display container is being used by at least one concern doing a large volume of fresh meat-cut business. This returnable container is substantially constructed with a wood exterior, a corrugated paper board insulated inner liner, and two removable lids. One solid insulated lid with a hasp lock is used during shipping movements. The other is a hinged double glass cover for use in the market, where the container may be used as a refrigerated display and service case. This combination container calls for solid CO_2 refrigeration employing the fin principle of temperature conductance through metal sheets that vertically line the box and extend from above the compartment containing the food products to the space that underlies the food compartment and contains the blocks of solid CO_2.

In addition to the 1-lb. capacity paper



Returnable container equipped with window lid

boxes mentioned previously in connection with the solid-pack method of freezing, fresh vegetables are wet-frozen in slip-cover, enamel-lined cans of varying sizes and capacities.

Throughout the refrigerated and frozen-food industry careful investigation and development are in progress to find ways and means of overcoming packaging and shipping problems that still handicap successful processing and merchandising of perishable food products. At this writing there are developments in advance stages of investigation that show promise of removing some of the present difficulties. The developments are so recent that last-minute thorough-going and conclusive tests are still under way.

Who Is Doing the Quick-Freezing

PRESERVATION of foods by what is commonly known as "quick-freezing" is, of course, still only a small part of the food-freezing industry. It is difficult to draw an arbitrary distinction between the relatively few plants engaged in so-called "quick" freezing and the thousands using the conventional "sharp freezer" methods. Moreover, there has been a tendency in certain quarters to minimize the real differences that do exist between the two systems.

The list of plants given below includes only those which make use of some special type of equipment or principle of operation to achieve freezing speeds which the users consider rapid enough to alleviate cell breakdown of the product. It does not include ice-cream plants, producers of bulk frozen meats, or "cold-pack" foods.

Company	Plant Location	Products Frozen	Method Used
Algonquin Sea Foods, Ltd.	St. Andrews, N. B.	Fish, clams, lobster	"Brino-Freeze" (Indirect brine method, developed by Canadian Biological Board.)
Atlantic Coast Fisheries Co.	Groton, Conn.	Fish and "fish steaks"	Cooke (Indirect brine)
Atlantic Coast Fisheries Co.	Jacksonville, Fla.	Shrimp	Cooke (Indirect brine)
Batchelder, Snyder, Dorr & Doe (General Foods Corp. subsidiary)	Boston, Mass.	Meats	Birdseye (Indirect brine)
Bay City Freezer (Inc.)	Bay City, Mich.	Fish	Petersen (Indirect brine)
Bay Fisheries Co. of Texas	Galveston, Texas	Fish, shrimp	Kolbe floating pan and diving bell (Indirect brine)
Bireleys	Hollywood, Calif.	Orange Juice	Frozen to slush, packaged and air hardened
Booth Fisheries Co.	Boston, Mass.	Fish	Kolbe floating pan (Indir. brine)
Booth Fisheries Co. (Freezer leased from H. A. Wilson Co.)	Portland, Me.	Fish	Kolbe floating pan (Indir. brine)
Borden Farm Products Co.	Tampa, Fla.	Orange juice	"Inver" ("Sealcones" in brine)
California Fruit Juice Co.	Sacramento, Calif.	Orange juice	Frozen to slush, packaged and air hardened.
Cudahy Packing Co.	Omaha, Neb.	Meats	Not made public (Frozen "very quickly")
Exchange Orange Products Co.	Ontario, Calif.	Orange juice	Frozen to slush, packaged and air hardened.
Florida Orange Juice Corp.	Winter Haven, Fla.	Orange juice	Hale (Indirect brine)
Food Products Co. (Galveston)	Corpus Christi, Texas	Shrimp	Indirect brine
Frigidized Food, Inc. (Nitterhaus Bros.).	Indianapolis, Ind.	Meat and fish	Kolbe floating pan (Indir. brine)
General Sea Foods Corp. (General Foods Corp. subsidiary)	Gloucester, Mass.	Fish (Fruit and vegetables, exper'm'tl)	Birdseye (Indirect brine)
Glynn Ice Co.	Brunswick, Ga.	Shrimp	Kolbe (Indirect brine)
Goldenhealth Fruit Products, Ltd.	Long Beach, Calif.	Orange juice	Frozen to slush, packaged and air hardened
Gorton-Pew Fisheries	Gloucester, Mass.	Fish	Kolbe floating pan (Indir. brine)
H. C. Hemingway & Co.	Syracuse, N. Y.	Vegetables and fruits	Hashlacher
Indian River Fisheries	Sebastian, Fla.	Fish	Matthews (Indirect brine)
Indianapolis Abbatoir Corp.	Indianapolis, Ind.	Meats	Kolbe floating pan (Indir. brine)
Irwin H. Kolbe Co.	Erie, Pa.	Fish	Kolbe (Indirect brine)
W. F. Kolbe & Co., Ltd.	Port Dover, Ont.	Fish	Kolbe (Indirect brine)
Leonard Fisheries, Ltd.	Port Hawkesburg, N.S.	Fish	Kolbe floating pan (Indir. brine)
Libby-Burchell Fisheries Co.	Vinalhaven, Me.	Fish	Kolbe floating pan (Indir. brine)
Lockeport Co., Ltd.	Lockeport, N. S.	Fish	Metal envelope (Indirect brine)
Manitoba Cold Storage Co., Ltd.	Winnipeg, Man.	Fish	Petersen (Indirect brine)
National Fish Co.	Halifax, N. S.	Fish	Cooke (Indirect brine)
National Juice Corp. (National Dairy Products subsidiary)	Tampa, Fla.	Orange juice	Modified Grayson (Frozen to slush in vacuum, packaged and air hardened)
A. E. Nickerson, Ltd.	Yarmouth, N. S.	Lobster	Indirect brine (in cans)
Polar Products, Inc.	Monticello, Ga.	Peaches	Grayson (Air)
Ray-Maling Company	Hillsboro, Ore.	Fruits and veg'tb'ls	Birdseye (Indirect brine)
Seven Seas Fisheries, Ltd.	Liverpool, N. S.	Fish	Kolbe floating pan (Indir. brine)
Swift & Co.	Chicago, Ill.	Meats	Not made public
Tampa Union Terminal.	Tampa, Fla.	Orange juice	Air
Tom Huston Frozen Foods, Inc.	Montezuma, Ga.	Peaches, Banana "cicles" (Orange juice, exper'm'tl)	Air
Traverse City Packing Co.	Traverse City, Mich.	Fish and fruit	Petersen (Indirect brine)
Whitman, Ward & Lee (General Foods Corp. subsidiary)	Boston, Mass.	Fish	Birdseye (Indirect brine)

Relation of Compressor Size To Freezing Temperature

STAFF ARTICLE
Food Industries

OWNERS of existing refrigerating plants who are now turning to low-temperature freezing will do well to examine the relation of compressor and driving motor capacities to the lower freezing temperatures that are to be carried. Otherwise there is real danger that the present compressor, while quite able to deliver its refrigeration rating at the old evaporator temperature, will not give over 50 per cent of this rating at the new lower temperature. It is also quite possible that the motor driving the compressor, under the new conditions, will be so underloaded as to cause the power cost per ton of refrigeration performed to be excessive. True, a ton of refrigeration is a ton of refrigeration, regardless of what temperature exists—always it is the removal of 200 British thermal units per minute from the refrigerating room. But the compressor must be able to handle enough refrigerant vapor to carry these 200 heat units out of the room.

A pound of liquid ammonia in the receiver contains a certain number of heat units. When this liquid enters the evaporator, or cooling coils, it picks up heat and changes into a vapor. The amount of heat a pound of vapor will contain depends upon the temperature and the pressure existing in the coils. For example, if the condenser pressure is 160 lb. gage, the pound of liquid contains 141 heat units. If the cooling coil temperature is 12 deg. F., so that the liquid ammonia will absorb heat and boil at 25 lb. gage, the pound will contain 615 heat units after it has become a vapor. The difference (615 — 141 = 474 heat units) is the heat absorbed from the cooler in doing refrigeration work. As a ton of refrigeration is the absorption of 200 B.t.u., evidently only 0.42 lb. of ammonia need be circulated per minute to perform a ton at this temperature. Now a pound of ammonia vapor at 25 lb. pressure has a volume of approximately 7 cu.ft., so that the compressor must handle 7 × 0.42 = 2.94 cu.ft.

Suppose we wish to operate the cooling coil at —17 deg. F., which means that the ammonia liquid will boil at 5 lb. gage pressure. Each pound of the —17 deg. vapor will contain 606 heat units, and by substituting the heat the liquid carried in with it—namely, 141 B.t.u.—we find that the net heat absorbed per pound will be 606 — 141 = 465 heat units. A cubic foot of —17 deg. vapor has a volume of 13.6 cu.ft. per pound, but, unfortunately, our compressor has a volume of only 2.94 cu.ft., so that we can handle only 2.94 ÷ 13.6 = 0.21 lb. of ammonia vapor at —17 deg. F. So the heat removed will be 0.21 × 465 = 97 + heat units. Since a ton of refrigeration is the removal of 200 heat units per minute, obviously the compressor has a piston displacement volume per minute that will permit it to handle ammonia doing but 97 ÷ 200 = 0.435 ton of refrigeration.

The same argument holds if the compressor under the 25 lb. suction pressure has been doing 100 tons; under the 5 lb. suction pressure it will do only 43.5 tons. The owner may be sorely disappointed if he attempts to use the old machine with the expectation that it will give as much refrigeration daily with 5 lb. and —17 deg. suction vapor as with 25 lb. and 12 deg. suction vapor.

Computations of this kind are tedious, so the curves in Fig. 1 have been prepared. These curves take into consideration the fact that a compressor will never draw in quite as much gas as its diameter and piston stroke would indicate, for there are losses by heating in the machine. The four curves will give the compressor displacement for four discharge, or head, pressures, for various suction pressures.

It will be observed from the heavy broken lines, inserted for an example, that with a discharge pressure of 160 lb. gage, at 25 lb. suction pressure, the

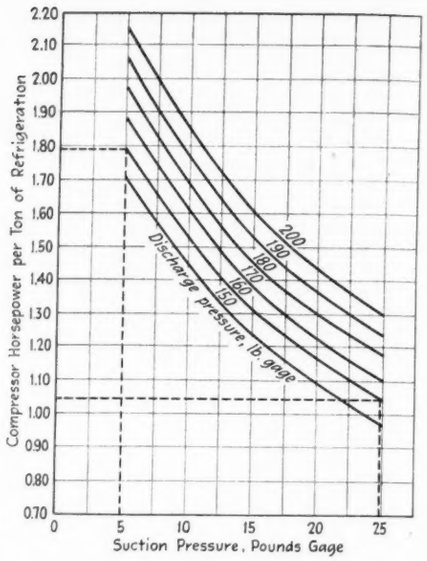
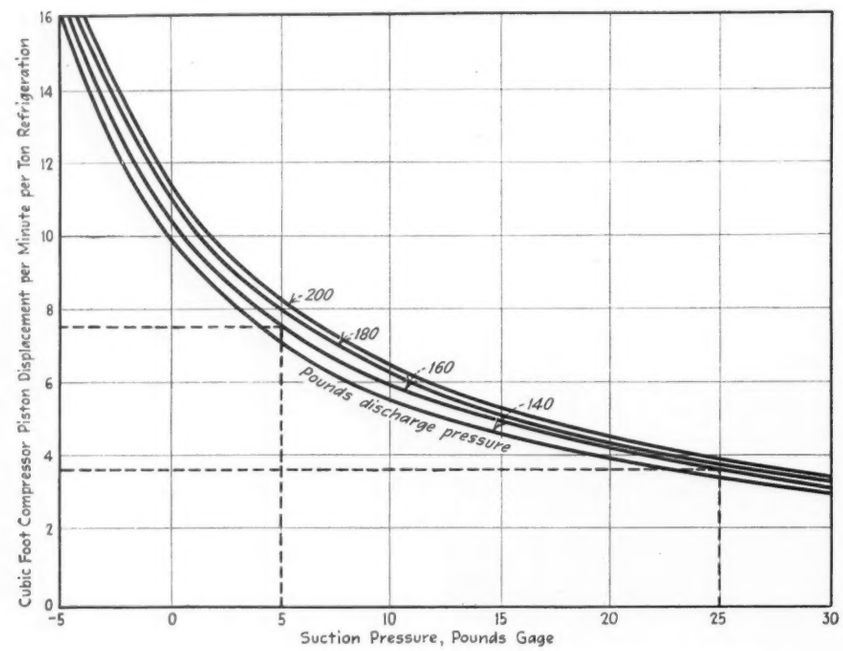


Fig. 2—Curves showing variation in horsepower required per ton of refrigeration for various suction and discharge pressures

Fig. 1—Curves showing how capacity of refrigeration compressors varies with suction pressure, which corresponds to temperature, for various compressor discharge pressures



compressor displacement per ton is about 3.75 cu.ft., while at 5 lb. gage the volume is about 7.5 cu.ft., or twice as much, which means that any given compressor will deliver but half the refrigeration at 5 lb. gage that it will do at 25 lb. suction pressure when the condenser or discharge pressure is 160 lb. At a different discharge pressure the ratio is slightly changed, as one may find by using Fig. 1.

We must not forget the motor driving the machine. The power needed to compress a cubic foot of suction vapor and discharge it into the condenser varies with a change in suction and discharge pressures, and the cubic feet of suction gas needed per ton of refrigeration increases with a decrease in pressure. Consequently the calculations are involved, so Fig. 2 has been prepared to eliminate the necessity for such laborious work. This gives the horsepower required by the compressor per ton of refrigeration for various suction and discharge pressures. Using the same examples as before, with a 160-lb. discharge pressure, the horsepower per ton is almost 1.8 with 5 lb. suction pressure and 1.05 with 25 lb. gage suction pressure. This would indicate at first glance that as the suction pressure decreased the compressor load increased. But remember that the compressor tonnage, from Fig. 1, at 5 lb. suction pressure, was but $\frac{3.75}{7.5}$ of the tonnage at 25 lb. So the compressor horsepower load at 5 lb. suction pressure would be but $\frac{1.8}{2} = 0.9$ hp., while at 25 lb. it is 1.05 hp. The motor will then operate somewhat underloaded, so that it will be less efficient.

A third factor also enters; this is the condenser cooling water. If at the higher suction pressures the condenser cooling surface is just sufficient to give a discharge pressure of 160 lb., then at the reduced suction pressure, with the reduced tonnage handled by the compressor, the condenser has less heat to remove. As a consequence the condensing temperature should be less, as should also the pressure, which may drop to 150 gage. The horsepower per ton at 150 lb. discharge pressure is 1.70 with a 5 lb. suction. The compressor motor load then, using the previously found values, is $\frac{1.7}{2} = .85$ hp., as compared to 1.2 with 25 lb. suction pressure and 150 lb. discharge. The motor is now considerably underloaded, which reduces the efficiency and raises the input horsepower per ton to about 2.4 hp. from the old value of 1.2 hp. with the 25 lb. suction.

In other words, the compressor capacity is reduced by operating at a low suction and the motor is underloaded, while the motor input per ton of refrigeration is doubled.

A Western Coast Cold-Storage Plant

By J. R. WEST
Chief Engineer, Port of Seattle
Seattle, Wash.

THE port of Seattle owns and operates two large cold-storage plants, both close to the waterfront, being separated from the ship's side by a transit shed and depressed railroad tracks and roadway. Bridges are provided, so that cargo can be trucked between cold-storage plant and ship directly through the transit sheds.

The Spokane Street cold-storage plant is the larger of the two and meets a greater variety of conditions. It consists of a seven-story reinforced concrete cold-storage warehouse, a timber-frame ice storage house and a timber-frame fish freezing and storage plant, all arranged along one side of a depressed roadway and two railroad tracks, with a separate one-story concrete building housing the ammonia compressors, condensers, and auxiliary equipment, as well as the ice-making plant.

Each of the upper six floors of the general cold-storage building is divided into six rooms, each room containing about 47,000 cu.ft. of net storage space. The ground floor is divided into smaller rooms which are insulated and piped for lower temperatures.

Refrigeration is supplied by direct expansion of ammonia in pipes installed in the storage rooms. The pipe coils are, in general, on the walls, but in some rooms where lower temperatures are required there are also ceiling coils. Walls and floors are insulated with cork board, covered with portland cement plaster. Air circulation in the rooms is provided by means of motor-driven fans that draw the air through ducts near the floor and discharge it through ceiling ducts with adjustable vents to provide for uniform distribution. The air ducts and fans are also arranged so as to permit the drawing in of air from outside the building.

Spokane Street cold storage plant, Seattle, showing depressed railroad tracks and loading icing platforms; the ice storage building is in the foreground

The storage of fresh eggs in this plant has been very successfully accomplished and large quantities are put in storage every year.

The frozen-berry and small-fruit industry has grown rapidly in the Pacific Northwest during the past few years. This fruit is largely packed in barrels with sugar, then shipped immediately to the cold-storage plant, where it is frozen solid at a low temperature and then placed in storage rooms.

Other foods, such as nuts, chocolate, apples, pears, butter, chicken, and reindeer meat, are successfully kept in storage at this plant. Immediately adjacent to the general cold-storage plant to the west is the ice storage building. This is a timber frame building insulated with granulated cork and cooled by direct-expansion piping on the ceiling. The ice travels from the ice plant along a tunnel by gravity under the roadway and railroad tracks to the elevator in the ice storage. This elevator raises the ice to the top of the pile in the ice storage or may be used for lowering ice from the pile to the chutes for delivery. The ice is used for supplying crushed ice to the fishing boats and for icing refrigerator cars.

The fish-freezing and cold-storage plant lies beyond the ice storage and is housed in a one-story wooden building insulated with granulated cork. The fish, after being landed, weighed, and cleaned, are laid on sheet metal plates that rest on banks of ammonia piping in the sharp freezer rooms. The temperature in the freezer rooms is held at about —18 deg. F. and this low temperature of the air, together with direct contact with ammonia piping, results in quick and complete freezing.

After the fish are frozen, while still very cold, they are dipped in a tank of fresh water to glaze the fish, in order to prevent evaporation and moisture. The fish are then piled in the storage rooms, where a temperature of about 20 deg. F. is maintained.

A small experimental laboratory under the U. S. Department of Agriculture has been established adjacent to the Spokane Street cold-storage plant for the purpose of carrying on investigations of modern methods of handling and storing food products.

In this table are assembled the more important provisions of state laws regarding cold-storage warehouses and cold-storage foods. In a number of states, fairly uniform provisions have been set up. These are referred to by the capital letters, and are assembled at the bottom of this page. Special provisions for each state are referred to under each state heading.

WHAT STATE LAWS SAY A

STATE*	AUTHORITY	Warehouse Definition	License Requirements	License Fee (annual)	Foods Included	Inspection Conditions	Records Required	Storage Marking Required	Storage Limit Required	Transfer Restrictions	Sales Restrictions	SPECIAL STATE PROVISIONS
Alabama	Dept. of Agriculture and Industries Montgomery, Ala.	None	None Req.	.....	.....	.....	.....	.....	.....	.....	(a)	(a) Cold storage eggs must be so labeled.
Arizona	State Board of Health Phoenix, Ariz.	None	None Req.	.....	.....	.....	.....	.....	.....	.....	(a)	(a) Eggs in cold storage for 3 months or more shall have the time in storage marked upon container. Sign "Cold Storage Food Sold Here." shall be displayed in salesroom.
California	State Board of Health San Francisco, Calif.	A-1,(a)	P	(b)	C,(c)	D	E	F	G	H	I,(d)	(a) Does not include home, hotel, restaurant, or exclusively retail establishment. (b) Plants 10,000 cu.ft. or less....$15 Plants 10,000 to 50,000 cu.ft...$30 Plants 50,000 to 100,000 cu.ft.$40 Plants over 100,000 cu.ft.....$50 (c) Also fresh fruits and vegetables, and cheese. (d) "These are cold storage goods" must appear on goods in letters 2 in. high, except where quality standards have been established by the Board, in which case the latter must be indicated.
Connecticut	Dairy and Food Commission Hartford, Conn.	None	None Req.	.....	.....	.....	.....	.....	.....	.....	(a)	(a) Eggs in storage with refrigeration for 15 days or more shall have "Cold Storage Eggs" on crate in 2-in. letters. Bags or containers shall have 1-in. letters on 2 sides.
Delaware	State Board of Health Dover, Del.	None	None Req.	.....	C-1,(a)	D	E	.....	G	.....	(b)	(a) Except fish and fruit. (b) Sale of cold storage undrawn poultry prohibited; eggs must be sold from original crate bearing date of storage.
Florida	No regulative cold storage laws (a)	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	(a) A law provides for erection and operation of publicly owned cold-storage plants, half the funds to be provided by the county and half by the State.
Georgia	Food and Drugs Department Department of Agriculture Atlanta, Ga.	None	None Req.	.....	.....	D	(a)	.....	.....	.....	(b)	(a) List must be kept of all eggs, date of receipt and withdrawal and to whom delivery is made. (b) Eggs must be labeled and placarded "Cold Storage Eggs."
Idaho	Department of Public Welfare Boise, Idaho	None	None Req.	.....	.....	.....	.....	(a)	.....	.....	.....	(a) All butter placed in storage shall have stamped on each container "Cold Storage Butter" and date when stored, in solid black type.

Uniform Provisions of Cold Storage Laws

A. "Cold storage warehouse" is any place where articles of food are kept for more than 30 days at a temperature of 45 deg. F. or below supplied by refrigeration.

A-1. Same as above, but with 40 deg. F. temperature limit.

B. License required by all cold storage warehouses. Issued annually after examination indicates satisfactory sanitary conditions. Revocable upon due notice if violations develop.

C. "Articles of food" means fresh meat, fresh meat products (except in process of manufacture), fresh fish, game, poultry, eggs, and butter.

C-1. "Articles of food" means any food, drink, or condiment consumed by man (except in process of mfg.).

D. Access to plant at any time must be accorded properly designated state authorities for inspection of plant and records.

E. Accurate records showing receipts, withdrawals, and holdings must be kept accessible to inspectors at all times. Quarterly reports of holdings must be submitted to state authority.

E-1. Same as above, but *monthly* reports are required.

F. Article or container must be plainly and permanently marked with date of entry and withdrawal. Material unfit for food must be so marked.

G. No foods shall be kept in storage longer than 12 months, except when an extension is granted after inspection by state authority.

H. Return of articles removed for sale to cold storage is unlawful.

Transfer from one warehouse to another is permitted when it does not involve evasion of law.

I. Articles of food, when offered for sale, must be marked to indicate that they are cold storage goods by placard on the bulk mass of articles. Unlawful to represent them as fresh.

I-1. A placard "Cold Storage Food Sold Here" must be displayed by those handling such products. Unlawful to represent such goods as fresh.

AY ABOUT COLD STORAGE

This table has been carefully compiled from state bulletins and statutes, and has been sent to state authorities for checking in every case. Brevity, however, has compelled the omission of a number of minor provisions, and led to the grouping of similar requirements that are not identical from the standpoint of legal technicalities.

STATE	AUTHORITY	Warehouse Definition	License Requirements	License Fee (annual)	Foods Included	Inspection Conditions	Records Required	Storage Marking Required	Storage Limit Required	Transfer Restrictions	Sales Restrictions	SPECIAL STATE PROVISIONS
Illinois	Division of Foods and Dairies State Department of Agriculture, Chicago, Ill.	A	B	$25	C	D	E-1	F	G,(a)	H	I	(a) Authorities may order removal from cold storage at any time for the following reasons: Fictitious price increase, monopoly, restraint of trade.
Indiana	Department of Foods and Drugs. Indianapolis, Ind.	A-1	B	$10	C,(a)	D	E,(b)	F,(c)	(d)	H	I,(e)	(a) Also cheese, fruits, farm or garden produce or any other perishable foodstuff. (b) Periodic reports not required. (c) Markings must be in black or purple ink; letters ½ in. high. (d) All goods in storage for 9 months must be inspected and passed by state authorities before sale. (e) The wrapper, bag, or container in which eggs are delivered to customer must bear the words, "Cold Storage."
Iowa	Department of Agriculture Des Moines, Ia.	A-1,(a)	B	$25	C-1	D	E	F	G	H	I-1,(b)	(a) Does not include home, hotel, or refrigerator car. (b) Letters of sign must be 3 in. high and 2 in. wide.
Kentucky	State Board of Health Louisville, Ky.	None	None Req.	.....	.....	.....	.....	.....	.....	.....	(a)	(a) An article of food is deemed misbranded if, when the length of time it has been stored tends to render it unwholesome, such aging or packing is not made known to the purchaser.
Louisiana	State Board of Health New Orleans, La.	A-1	B	None	C-1	D	E	F	G	H	I-1	
Maryland	State Board of Health Baltimore, Md.	A	B	$25	C, (a)	D	E-1	F	G, (b)	H	I	(a) Includes all fish. (b) Extension shall be for not more than 60 days. Second extention of 60 days may be permitted after re-examination, but no more than 120 days in all.
Massachusetts	Department of Public Health Boston, Mass.	A	B	$10	C, (a)	D	E-1	F, (b)	G	H	I-1,(c)	(a) No fish shall be placed in storage that has not been graded No. 1 or No. 2. (b) But date of withdrawal not required. (c) No fish may be sold more than 48 hours after receipt from cold storage, unless received and sold frozen, except Nov. 1 to March 31. Halibut, salmon, swordfish and steak-cod may be sold one week after receipt if they remain frozen until 48 hrs. before time of sale.
Michigan	Department of Agriculture Lansing, Mich.	.....	.....	.....	.....	.....	.....	.....	.....	.....	(a)	(a) Eggs in storage at 40 deg. F. or below for 30 days must be marked "Cold Storage Eggs."
Minnesota	Department of Agriculture St. Paul, Minn.	A, (a)	B, (b)	$50	C-1	D	E-1,(c)	F	G,(d)	H	I-1,(e)	(a) Except refrigerator cars or ships. (b) Schedule of rates must be filed and kept open for public inspection. (c) Uniform receipts required. (d) Same as (b) for Maryland. (e) Official placards, cancelable and not transferable, must be obtained from Dept. (Fee $0.50).
Montana	Department of Public Health Helena, Mont.	None	None Req.	.....	.....	.....	.....	.....	.....	.....	(a)	(a) Cold storage eggs must be so labeled.
Nebraska	Department of Agriculture Lincoln, Neb.	(a)	B	$5, (b)	C-1	D, (b)	E	F	G	H	(c)	(a) Keeping articles of food at 40 deg. F. or below for 60 days. (b) Inspection fee of: $10 for less than 50,000 cu.ft. $25 for 50,000 to 100,000 cu.ft. $50 for over 100,000 cu.ft. is required annually. (c) Purchasers must be notified that product is storage goods.
New Hampshire	State Board of Health Concord, N. H.	A-1	B	$10	C	D	E	F	G	H,(a)	(b)	(a) No transfer permitted after 11 months storage except with extension granted by board. (b) Egg and poultry packages must be stamped "Cold Storage" in cap. letters not less than ½ in. square.
New Jersey	Bureau of Foods and Drugs Department of Health, Trenton, N. J.	A, (a)	B	$10	C, (b)	D	E-1	F	G	H	I	(a) Does not include refrigerators maintained by wholesale or retail grocers. (b) Also edible fats, cheese and miscellaneous milk products.

STATE	AUTHORITY	Warehouse Definition	License Requirements	License Fee (annual)	Foods Included	Inspection Conditions	Records Required	Storage Marking Required	Storage Limit Required	Transfer Restrictions	Sales Restrictions	SPECIAL STATE PROVISIONS
New York	Department of Agriculture and Markets Albany, N. Y.	A,(a)	B,(b)	$25,(c)	C-1,(d)	D	E-1,( )	(f)	G	H	(g)	(a) Except for home use. (b) Financial responsibility also must be established. (c) Cold storage warehouses handling fruits and vegetables exclusively, $10. For each warehouse in excess of one, $5. (d) No exception for process of mfg. (e) Confidential financial statements may also be required at any time. (f) Identification lot number. (g) Invoice must indicate storage.
North Dakota	State Food Commissioner and Chemist, Bismarck, N. D.	(a)	None	.....	.....	.....	.....	F	.....	.....	(b)	(a) Any place where food is artificially cooled to 40 deg. F. or below, except private home, restaurant, hotel, or ref. car. (b) Cold storage goods must be so labeled.
Ohio	Division Foods and Dairies Department of Agriculture Columbus, Ohio	A-1	B	$50	C	D	E	F	G,(a)	H	(b)	(a) No provision made for time extension. (b) Each container of cold storage food shall be labeled "wholesome cold storage food" in letters at least ½ in. high. Placard with same legend must be posted.
Oregon	Dairy and Food Dept. Portland, Ore.	.....	.....	.....	(a)	.....	.....	.....	G	.....	.....	(a) Poultry, rabbits and fish.
Pennsylvania	Bureau of Foods Department of Agriculture.... Harrisburg, Pa.	A-1	B	$50	C	D	E	F	G,(a)	H	I,(b)	(a) No provision for time extensions. (b) "Cold storage goods" must also be stamped on retail wrapper.
Rhode Island	Food and Drug Commission Providence, R. I.	None	None Req.	.....	.....	.....	.....	.....	.....	.....	(a)	(a) Eggs stored for 30 days at 40 deg. F. or below are "cold storage eggs" and container must be so marked. Placard must appear in connection with display of such eggs in bulk.
South Dakota	Department of Agriculture Pierre, S. D.	None	None Req.	.....	.....	.....	.....	.....	.....	.....	(a)	(a) Cold storage eggs must be so labeled.
Tennessee	Department of Agriculture Nashville, Tenn.	A,(a)	B	$10	C	D	E-1	F	G	H	I	(a) Does not apply to refrigerators of retail or wholesale grocers.
Utah	Commissioner of Dairy and Food Salt Lake City, Utah	A	B	$10	C	D	E-1	F	G	H	.....	
Vermont	No cold storage laws	.....	.....	.....	.....	D,(a)	.....	.....	.....	.....	.....	(a) Dept. of Public Health has right to inspect all places where food is made, packed, stored or sold.
Virginia	Dairy and Food Commissioner Richmond, Va.	A,(a)	B,(b)	$25,(c)	C,(d)	D	E	F	(e)	H	I	(a) Does not apply to refrigerators of wholesale or retail dealers. (b) No public cold-storage warehouse charging for food storage shall directly or indirectly own or deal in food commodities stored in such warehouse except those legally acquired for charges. (c) Except when gross business is less than $1,000, $5; $1,000 to $2,000, $10; over $2,000, $25. (d) Also cheese, edible fats and oils and lard. (e) No food shall be kept in storage longer than 10 months, without consent of Commissioner. No cold-storage warehouseman shall loan or incur liability in connection with loans on food stored in such warehouse in excess of 70 per cent of the market value of such food.
Washington	Division of Foods, Feeds, Fertilizer and Drugs Depart nent of Agriculture Olympia, Wash.	None	None Req.	.....	.....	.....	.....	.....	(a)	.....	(b)	(a) Eggs in cold storage for more than 9 months can only be sold after obtaining permit. (b) Eggs in cold storage more than 90 days must be labeled "Storage."
Wisconsin	Dairy and Food Commissioner Madison, Wis.	(a)	B	(b)	C,(c)	D	E-1	F	G,(d)	H,(e)	I	(a) "Cold Storage Warehouse" shall mean any place where foods are artificially cooled to or below 45 deg. F., for 40 days or more. (b) In first class city, $40. In second class city, $30. In third class city, $20. In fourth class city, $10. (c) Also butter substitutes. (d) Extension shall not exceed 30 days. (e) Eggs and butter may be returned for further storage after examination if markings remain thereon.
Alaska	Office of the Auditor Juneau, Alaska	.....	(a)	.....	.....	.....	.....	.....	.....	.....	.....	(a) License fees required as follows: For gross income of— $100,000 or more per year.... $500 $75,000 to $100,000 per year. $375 $50,000 to $75,000 per year.. $250 $25,000 to $50,000 per year.. $125 $10,000 to $25,000 per year.. $50 $4,000 to $10,000 per year... $25 Under $4,000 per year..... $10

*Arkansas, Colorado, Kansas, Maine, Mississippi, Missouri, Nevada, New Mexico, North Carolina, Oklahoma, South Carolina, Texas, West Virginia, Wyoming and District of Columbia have no cold storage laws.

Geographic distribution of total refrigerated warehouse space

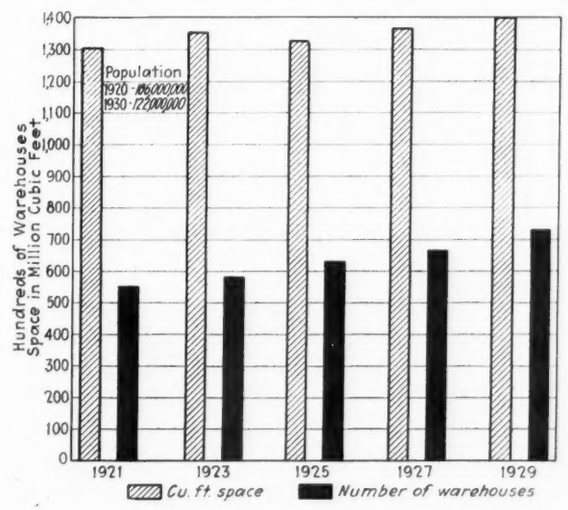
Trends in Cold Storage Space And Holdings

By WILLIAM BROXTON

Assistant Marketing Specialist
Bureau of Agricultural Economics
U. S. Department of Agriculture

THE following statement regarding cold-storage warehouses has been compiled from the files of the Bureau of Agricultural Economics of the U. S. Department of Agriculture. The basis of the information is arrived at from surveys which have been made biennially for a number of years. The first figures available are as of Oct. 1, 1921. This survey showed 1,302 concerns which could be considered as doing a cold-storage warehousing business and the total capacity of those warehouses was 543,572,892 cu.ft. By October 1929, the cold-storage warehouse industry had increased to 1,400 concerns with a total capacity of 728,594,833 cu.ft. of space, an increase of 98 concerns and 185,021,941 cu.ft., or 34 per cent.

The concerns included in this survey were public cold-storage warehouses, private warehouses, combined public and private warehouses—that is, private concerns who primarily use a refrigerated plant for carrying the commodities in which they dealt and who incidentally catered to some public business—meat-packing establishments, and meat packing establishments that also did some public warehousing.



Growth of refrigerated warehouse space

These figures do not include distribution warehouses of produce merchants and branch houses of meat-packing concerns, whose commodities are constantly turning over from week to week. In the 1921 survey of refrigerated warehouse space, 342 public warehouses with a total capacity of 194,166,381 cu.ft. were included. These were increased by 1929 to 517 concerns with a capacity of 316,810,362 cu.ft. In 1921, 23 per cent of the total space was devoted to freezer rooms and 77 per cent to cooler rooms; the public plants showed 33 per cent freezer rooms and 67 per cent cooler.

These warehouses and meat-packing establishments were in 1929 distributed as follows (using the Census geographic divisions): New England had 4 per cent; Middle, 20 per cent; East North Central, 29 per cent; West North Central, 22 per cent; South Atlantic, 5 per cent; East South Central, 2 per cent; West South Central, 4 per cent; Mountain, 2 per cent; and Pacific, 12 per cent. The distribution of public warehouse space was: New England, 4 per cent; Middle Atlantic, 33 per cent; East North Central, 23 per cent; West North Central, 9 per cent; South Atlantic, 9 per cent; East South Central, 3 per cent; West South Central,

Geographic distribution of *public* refrigerated warehouse space

3 per cent, Mountain, 1 per cent; and Pacific, 15 per cent.

There seems to be quite a variation of freezer and cooler space as between the various geographic sections of the country; New England has 53 per cent freezer and 47 per cent cooler space. This undoubtedly is due to the large amount of freezer capacity needed for the handling of fish, large quantities of which go to the New England ports for freezing. The opposite extremes will be noted in the South Atlantic, West South Central, and the Pacific sections, which have 15 per cent freezer and 85 per cent cooler; 13 per cent freezer and 87 per cent cooler; and 19 per cent freezer and 81 per cent cooler, respectively. This situation is due to the large number of warehouses devoted to the storing of apples and other produce for which freezer space is not required. The Middle Atlantic section shows freezer space, 26 per cent, and cooler space 74 per cent; East North Central, 29 freezer and 71 cooler; West North Central, 31 per cent freezer and 69 per cent cooler; East South Central, 21 per cent freezer and 79 per cent cooler; West South Central, 13 per cent freezer and 87 per cent cooler; and the Mountain section, 32 per cent freezer and 68 per cent cooler.

In analyzing the public cold-storage warehouse situation, it is found that the largest amount of space is held in the Greater New York area, which includes Manhattan, the Bronx, Brooklyn, Jersey City, N. J., and Hoboken, N. J. In this area were located at the time of the last survey 30 concerns with a total capacity of 39,856,555 cu.ft. of refrigerated space. This was made up of 13,847,053 cu.ft. of low-temperature and 26,009,502 cu.ft. of cooler space. Since the 1929 survey was made, a large terminal has been erected on the river front at Jersey City, which advertises 8,000,000 cu.ft. of cold-storage warehouse facilities.

Next in order of magnitude follows Chicago, which shows ten enterprises devoted to public warehousing whose total refrigerated capacity is 35,875,150 cu.ft.; 29 per cent freezer and 71 per cent cooler.

Philadelphia ranks next in order with nine warehouses of a total cold-storage space of 11,791,537 cu.ft.; 35 per cent freezer and 65 per cent cooler temperature.

Cleveland has six public warehouses with 10,911,653 cu.ft. of refrigerated space, 28 per cent of its capacity being freezer rooms and 72 per cent cooler. St. Louis, Mo., and East St. Louis, Ill. (combined), has six public plants with a total capacity of cold-storage facilities of 10,197,417 cu.ft., made up of 31 per cent freezer and 69 per cent cooler.

Boston's refrigerating needs are ac-

Table I—Refrigerated Space: Summary by Class of Business, Oct. 1, 1929

Class of Business	Warehouses Number	Space held at temperatures of— 10° F. and below Cubic Feet	11°-29° F. Cubic Feet	30°-44° F. Cubic Feet	45°F. and above Cubic Feet	Total Space Cubic Feet
Meat-packing establishments	375	15,169,545	37,573,575	188,735,270	24,786,577	266,264,967
Private cold storages	270	3,872,250	3,257,576	21,243,827	758,961	29,132,614
Public cold storages	517	58,031,905	23,573,398	228,447,025	6,758,034	316,810,362
Combined public and private cold storages	209	8,951,567	8,801,609	41,709,130	859,442	60,321,748
Packing establishments doing a public cold-storage business	29	8,760,555	2,574,447	39,874,438	4,855,702	56,065,142
Total	1,400	94,785,822	75,780,605	520,009,690	38,018,716	728,594,833

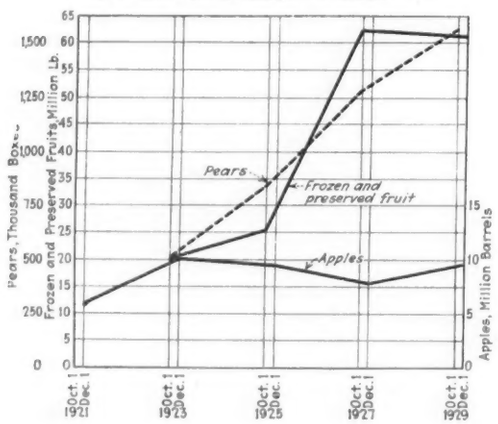
From U. S. Dept. Agri. Statistical Bulletin No. 33.

Table II—Cold-Storage Stocks by Geographical Divisions for Year 1929

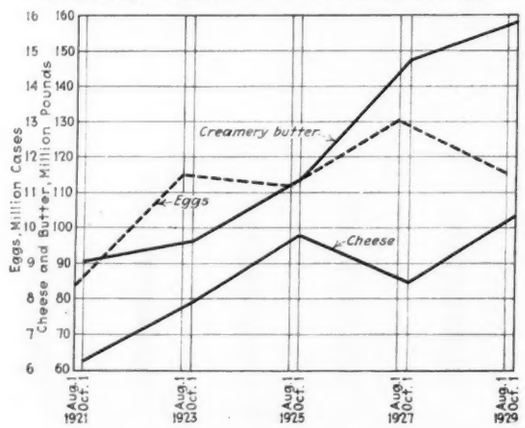
Commodity	New England Per Cent	Middle Atlantic Per Cent	East North Central Per Cent	West North Central Per Cent	South Atlantic Per Cent	East South Central Per Cent	West South Central Per Cent	Mountain Per Cent	Pacific Per Cent
Apples	2	22	12	6	15	1	2	1	39
Creamery butter	11	26	30	22	1	3	2	1	4
Cheese	4	31	48	3	4	2	1	2	5
Case eggs	5	29	30	18	2	4	3	1	8
Frozen eggs	2	22	31	29	2	3	5	..	6
Poultry	8	42	31	12	..	1	2	..	4
Beef	2	20	48	19	1	..	7	1	2
Pork	4	6	40	40	3	1	2	2	2
Lamb and mutton	11	43	22	19	..	..	1	2	2
Meats (total)	4	7	40	40	3	..	2	2	2
Lard	7	6	65	16	1	..	..	2	3

From U. S. Dept. Agri. Statistical Bulletin No. 33.

Cold-storage holdings of fruits



Cold-storage holdings of butter, cheese, and eggs



commodated by three enterprises totaling 9,678,984 cu.ft., of which 56 per cent is freezer and 44 per cent cooler. Detroit has seven warehouses with refrigeration totaling 8,880,510 cu.ft.; 39 per cent of which is freezer and 61 per cent cooler.

The Pacific Coast is adequately provided for in the way of cold-storage facilities. Six organizations in Los Angeles operate 6,917,706 cu.ft.; three in San Francisco operate 4,931,767 cu. ft.; the combined freezer and cooler space for these two cities is 22 and 78 per cent, respectively. Seattle has six concerns doing a public cold-storage business with a total refrigerated capacity of 6,107,522 cu.ft.; 25 per cent freezer and 75 per cent cooler.

As previously mentioned, while the percentage of freezer and cooler space is more or less consistent generally, there are two or three outstanding exceptions, which may be illustrated by the following: The State of New York has public warehouses whose total capacity of refrigerated rooms runs to 65,865,976 cu.ft. and whose freezer and cooler temperatures are 24 per cent and 76 per cent, respectively. This arrangement is apparently consistent for a territory whose stocks of perishables are considerably diversified.

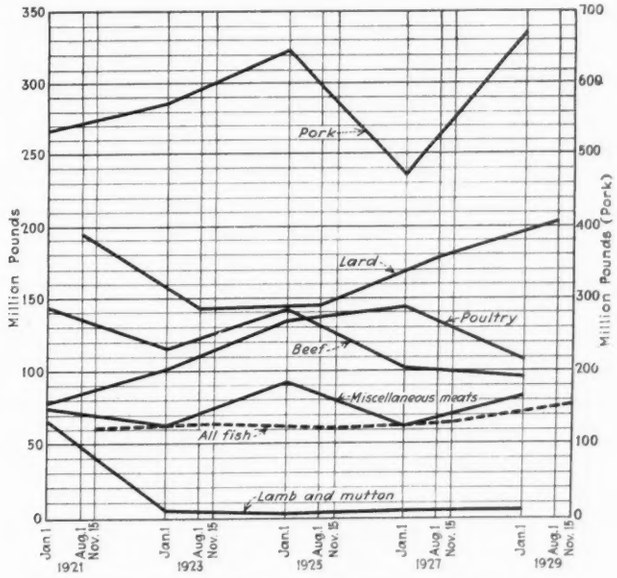
Illinois has a similar arrangement, with 39,642,492 cu.ft. segregated into 27 per cent freezer and 73 per cent cooler. On the other hand, the State of Washington, whose cold-storage stocks are in the main apples and other fruits which do not require low temperatures, has 21,743,305 cu.ft. of space, 10 per cent of which is freezer and 90 per cent cooler.

Virginia, whose warehouses are devoted chiefly to the storing of apples, has 14,855,131 cu.ft.; 7 per cent of this is of freezer temperatures and 93 per cent is cooler. Texas, which handles large quantities of fruits, nuts, and vegetables, has 5,097,905 cu.ft. of cold-storage warehouse facilities with 13 per cent freezer and 87 per cent cooler.

The opposite is shown in Massachusetts, where large capacity of lower temperature is needed for the freezing and storing of fish; the total public warehouse space having refrigeration is 11,052,145 cu.ft.; 54 per cent of which is freezer space and 46 per cent cooler.

Table III—Total Refrigerated Space: All Cold Storages, Including Meat-Packing Establishments, Reporting to the Bureau of Agricultural Economics Oct. 1, 1929

State	Concerns Number	Space Held at Temperatures of — 10° F. and below Cubic Feet	11°-29° F. Cubic Feet	30°-44° F. Cubic Feet	45° F. and above Cubic Feet	Total Space Cubic Feet
Alabama	7	140,000	50,604	1,149,091	55,822	1,395,517
Alaska	4	487,822	535,892	7,776	.....	1,031,490
Arkansas	6	5,600	57,760	1,442,400	50,000	1,555,760
California	72	2,237,462	1,933,894	23,554,542	787,473	28,513,371
Colorado	21	1,147,411	855,162	4,902,612	506,405	7,411,590
Connecticut	8	278,000	96,350	1,123,305	146,000	1,643,655
Delaware	3	78,000	9,630	526,461	71,701	685,522
District of Columbia	4	298,244	1,081,984	1,196,235	48,966	2,625,429
Florida	14	291,050	167,780	1,383,936	174,372	2,017,138
Georgia	21	249,948	332,760	3,196,143	104,609	3,883,460
Idaho	13	56,831	118,271	1,132,259	128,956	1,436,317
Illinois	79	20,733,119	27,268,317	73,599,703	8,562,049	130,163,188
Indiana	44	1,735,881	1,158,130	14,292,523	1,059,694	18,246,228
Iowa	36	2,584,252	2,540,195	18,767,650	1,958,118	25,850,215
Kansas	31	3,686,907	3,400,131	31,364,928	6,058,715	44,510,681
Kentucky	15	353,515	422,208	4,801,036	43,814	5,620,573
Louisiana	8	293,886	48,589	2,171,623	.....	2,514,098
Maine	11	607,337	66,750	535,705	4,907	1,214,699
Maryland	17	655,544	685,982	4,170,907	236,376	5,748,809
Massachusetts	38	8,231,612	628,757	14,527,885	7,584	23,395,838
Michigan	40	3,268,275	1,900,175	10,874,449	40,497	16,083,396
Minnesota	27	4,157,172	2,770,126	20,252,867	3,438,502	30,618,667
Mississippi	5	21,456	23,470	75,200	23,455	143,581
Missouri	50	4,979,161	2,902,329	28,038,332	1,157,505	37,077,327
Montana	6	23,583	54,050	212,541	9,540	299,714
Nebraska	22	3,420,438	2,385,775	14,648,520	1,018,597	21,473,330
New Jersey	37	4,865,881	1,413,053	14,961,988	1,030,111	22,271,033
New York	198	12,916,321	5,250,392	70,037,873	2,620,789	90,825,375
North Carolina	10	.....	75,342	358,987	119,960	554,289
Ohio	87	4,561,743	3,085,442	23,410,759	927,887	31,985,831
Oklahoma	12	384,376	1,109,561	4,999,684	955,240	7,448,861
Oregon	32	1,670,420	1,506,225	6,224,479	196,027	9,617,151
Pennsylvania	96	4,866,716	3,032,174	24,170,186	411,150	32,480,226
Rhode Island	4	338,168	406,000	822,928	.....	1,567,096
South Dakota	8	127,354	475,610	2,884,674	651,499	4,139,137
Tennessee	20	814,258	419,066	4,378,019	214,391	5,825,734
Texas	50	1,179,884	1,034,132	11,976,686	1,504,693	15,695,395
Utah	7	143,641	196,854	1,271,048	26,112	1,637,655
Virginia	26	88,060	1,089,454	16,404,903	21,400	17,603,817
Washington	120	1,199,532	3,842,771	42,124,296	2,362,381	49,528,980
West Virginia	17	4,000	90,051	4,811,893	41,996	4,947,940
Wisconsin	60	1,558,218	888,007	12,255,219	1,161,121	15,862,565
All other States	14	44,744	371,670	947,439	80,302	1,444,155
Total	1,400	94,785,822	75,780,605	520 009,690	38,018,716	728,594,833



Cold-storage holdings of poultry, meat, lard, and fish

NEWS OF THE MONTH

Plan Frozen Foods Company For Pacific Coast

A NEW company, to be known as Pacific Frosted Foods, Inc., is being organized by the General Foods Corporation and the Standard Oil Company of California to produce and sell quick-frozen foods on the Pacific Coast. It will function under joint control of the two parent companies.

A license arrangement is planned by which the new company will be permitted to employ the Birdseye freezing process in the states of Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington, and Wyoming; also in western Mexico, Alaska, and Hawaii.

The new organization will have at its disposal scientific and marketing data accumulated by General Foods Corporation. Standard Oil Company of California is in position to contribute substantially toward the rapid establishment of production and distribution facilities in the territories to be served by the new company, for through its control of the Pacific Public Service Company it controls the latter company's subsidiary, known as the California Consumers Company, which now owns and operates nine important ice-manufacturing plants and four cold-storage plants.

Meats to be frozen in the quick-freezing plant to be established on the Pacific Coast will be purchased from Western meat-packing organizations. In view of the fact that many of the varieties of quick-frozen fish that are popular with the consumer are not obtainable on the Pacific Coast, the California company will draw its supply from the Eastern plant of General Foods Corporation. Fruit and vegetables, which for some time past have been quick-frozen by the Ray-Maling Company, of Hillsboro, Ore., will be supplied by that company under the new arrangement.

Independent as well as chain food stores and other retail outlets are expected to handle the products. Preliminary plans call for the establishing of 300 retail outlets during the first year of operation. It is expected that resistance from retailers will be greatly reduced through a special arrangement by which they can purchase low-temperature display and storage cabinets on advantageous terms.

Retail distribution is to be expanded as rapidly as is found practical and in the course of five years 10,000 to 12,000 retail outlets are expected to handle quick-frozen foods in the Pacific Coast territory.

COMING EVENTS

MAY

April 30—May 1-2—American Institute of Refrigeration, Ritz-Carlton Hotel, Atlantic City, N. J.

4-9—Chemical Industries Exposition, Grand Central Palace, New York City.

6-8—American Society of Refrigerating Engineers, Kansas City, Mo.

7—National Cheese Institute, Inc., Schroeder Hotel, Milwaukee, Wis.

12-14—National Food Brokers' Association, Roosevelt Hotel, New Orleans, La.

13-15—Millers' National Federation, Edgewater Beach Hotel, Chicago, Ill.

14-15—American Oil Chemists' Society, New Orleans, La.

18-20—National Cottonseed Products Association, Roosevelt Hotel, New Orleans, La.

18-21—American Association of Cereal Chemists, Brown Hotel, Louisville, Ky.

19-21—First Packaging Exposition (Consumer Marketing Division of American Management Association), Hotel Pennsylvania, New York City.

20-22—Flavoring Extract Manufacturers' Association of the U. S., Hollenden Hotel, Cleveland, Ohio.

28—Rice Millers' Association, New Orleans, La.

JUNE

1-5—Association of Operative Millers, Kansas City, Mo.

2-5—National Confectioners' Association, Stevens Hotel, Chicago, Ill.

8-9—Certified Milk Producers' Association of America, Adelphia Hotel, Philadelphia, Pa.

16—National Macaroni Manufacturers' Association, Edgewater Beach Hotel, Chicago, Ill.

25-26—National Live Stock and Meat Board, Chicago, Ill.

Mayonnaise Industry Shows Steady Growth

MANUFACTURE of mayonnaise and allied products continued during 1930 the progress it has shown in the past three years, according to the latest annual survey of this industry by the Foodstuffs Division of the Department of Commerce. An increase of 18.7 per cent in 1930 over 1929, as compared with an increase in 1929 of 17.9 per cent over 1928, is shown by returns from 73 concerns estimated to represent more than two-thirds of the production.

"There is apparently a close relationship between carload shipments of lettuce and monthly sales of mayonnaise and related products," says R. S. Hollingshead, in charge of the survey for the Foodstuffs Division. This suggests the possibility of control of production by correlation with carload shipments of lettuce, in view of the fact that fluctuations in these shipments are a month ahead of similar fluctuations in mayonnaise sales.

The 1930 production of the firms reporting was valued at $38,169,503. Of this amount, $25,860,457 represented sales of mayonnaise and $12,309,046 represented salad dressings, sandwich spreads, French dressings, and similar products.

Veto Kills Bill Outlawing Frozen Package Meats

THE bill which would have forbidden the sale of package frozen meats in the State of Maryland was vetoed on April 17 by Governor Albert C. Ritchie after a hearing on April 14 at which both opponents and proponents of the legislation explained their views. The avowed purpose of the bill was to protect Maryland meat packers and dealers against competition from non-resident packers using this method of preservation and packaging.

In a statement setting forth his reasons for vetoing the bill, Governor Ritchie said: "As a matter of fact, the bill, if approved, would not, and from the nature of things could not, accomplish its purpose.

"The process is concededly wholesome, sanitary, and healthy, and the meat treated by it is fit and proper for human food. This being so, it is perfectly clear that the state has no power to prevent the shipment of such frozen meats from other states into Maryland. When questions of health and sanitation are not involved, then no state can discriminate against the food products of other states and exclude them from its markets. Neither the present bill nor any other bill could have that effect. This has been decided by the courts many times.

"Therefore, the only effect Senate Bill 183 could have would be to prohibit local packers and local dealers from using the new process, should they want to use it for the benefit of local consumers who might desire it. . . . This bill, if approved, would purport to deny them that right. It may be added that the process, if and when perfected, may be of great value to other lines of industry in this state, such, for instance, as Maryland oysters, crabs, and fish. It may preserve Maryland sea food in a way which would enable its shipment to distant points with complete safety."

Revision of Mapes Act Standards Follows Criticism of Canners at Hearings

By Paul Wooton
Washington Correspondent

MAPES Act standards for canned tomatoes, apricots, and cherries, as finally revised, will be issued in the immediate future. As a result of representations made by canners at hearings held in Washington and San Francisco April 13 and 14, respectively, specifications tentatively issued several weeks ago will be modified in some important respects.

Debate at the hearings was directed principally to the standard for tomatoes. The final standard will be more lenient both as to the color requirement and as to the amount of peel permitted. It is not likely that any variation in the solid contents in its relation to the size of the can will be permitted. Food control officials appreciate the fact that the contents of larger cans tend to break up to a greater extent than that of smaller cans because of the longer period of heating required, but they hold that a single standard is essential. The standard will not require that the California product now labeled "tomatoes with puree from trimmings" bear the sub-standard legend.

At the Washington hearing the Tri-State Packers' Association suggested that the definition of canned tomatoes be revised to eliminate drainage from the peeling table. Color samples exhibited at the hearing caused considerable protest, but at a subsequent meeting in the laboratory the canners were given an opportunity to express their opinions as to the grade of several cans of tomatoes opened for the purpose. Three cans were selected by the canners as being at practically the lower limit for color in standard tomatoes.

William Silver and other representatives of the Tri-State association urged that the peel allowance be increased from 1½ to 2¼ sq.in. John P. Street, representing the Association of New York State Canners, suggested 3 sq.in., while spokesmen for the Indiana association and the California league stated that the 1½ sq.in. allowance is satisfactory. Eastern canners modified their opposition to this requirement when Dr. W. B. White, chief of food control, explained that in no case would action be taken on a sample of less than 24 cans and that in larger lots a larger sample would be taken. Greater latitude will be allowed in the standard as finally promulgated, however, as the food control officials recognize that the cost factor involved in keeping the amount of peel down to an unreasonably low minimum cannot be ignored.

With reference to the requirement that there shall not be more than one unsightly blemish for each 8 oz. of net contents, the Tri-State association recommended that there be a limit of not more than ¼ sq. in. of total blemish, and that the unit be increased from 8 oz. to 1 lb. This was regarded by the New York group as too large a tolerance.

Tri-State packers suggested that the drained weight requirement, which is 40 per cent of the total contents regardless of the size of the can, be scaled up from 40 per cent for a No. 10 can to 45 per cent for No. 2½ and No. 3 cans and 50 per cent for No. 2 and smaller sizes. The Indiana association suggested 55 per cent as the minimum. The California league regarded 40 to 45 per cent as about right.

The exception made in the tentative standard for "tomatoes with added strained tomatoes" brought a protest from the Tri-State packers, while the spokesman for the California league objected to the proposal of their Tri-State competitors that the California product with added puree be required to bear the "Indian" sign, as the sub-standard label is commonly referred to.

With respect to the apricot standard, the California league suggested that the put-in weight be reduced from a minimum of two-thirds to a minimum of three-fifths, and that the tolerance, necessary to prevent crushing of the fruit, be raised from the equivalent of one average piece to two average pieces. Mr. McKinney also recommended that the weight for a normal unit be considered as ⅜ oz. instead of ⅓ oz., and that the relation between diameter of units be changed from a variation of 25 per cent to 12.5 per cent. In connection with the provision that the fruit shall be considered unblemished if 80 per cent of the pieces in the can are free from unsightly blemish, Mr. McKinney suggested an additional requirement that of the permissible 20 per cent of blemished fruit none should show blemishes exceeding 10 per cent of their total surface area.

Under the exception made for water-packed apricots, the New York canners recommended that the word "unsweetened" be substituted for the term "water-packed." The California league suggested substitution of the term "packed in water" for "water-packed," as the latter has become in practice a grade designation. The California league recommended inclusion of provisions that would make an exception to the standard in the case of sliced-peeled apricots and whole-peeled apricots.

Changes were recommended in the standard for canned cherries to make it applicable to sour cherries grown in Michigan, New York, and Colorado. With that purpose in view, the New York association suggested that the Brix reading be reduced from 16 deg. to 12 deg. The California league was reluctant to accept this change. The Michigan packers objected to the put-in weight requirement, contending that the put-in weight of 62.5 oz. in a No. 10 can of sour cherries would be much less than normal. The California league also raised the question whether it would be possible to exempt pie fruit in No. 10 cans from the sub-standard legend.

Food Prices Not Yet On Bottom

Despite the reassuring indications of general business conditions as intimated by the 2.8-per cent rise in *The Business Week* index for the month ending March 15, wholesale food prices registered a continued downward tendency. This decline was only 0.52 per cent, in comparison with the 3.75 per cent decline of the previous month, during which period general business conditions showed a decline of 3 per cent. All commodities declined 1.33 per cent in wholesale prices during the month ending March 15, as compared with a 1.95 per cent decline for the month ending Feb. 15.

The total decline in wholesale food prices for the year ending March 15 was 18.32 per cent, as compared with a 17.95 per cent decrease for all commodities for the same period and a total decrease of 19.27 per cent in wholesale food prices for the year ending Feb. 15.

Retail food prices continue to be under fire and have been showing a general decrease, with marked weaknesses in spots.

In the past month *The Business Week* index has fallen from 81 per cent of normal, as reported in the April issue of Food Industries, to 77.7 per cent.

Movie Magazine to Use Stars To Build "Kitchen Appeal"

FOOD tastes of screen stars, interpreted through the new "Hostess" department of *Modern Screen* magazine, will be used to reconcile movie-mindedness with good cookery, if publishers of the magazine going each month to 650,000 shoppers in Kress and Kresge stores, located in 537 cities of over 10,000 population, achieve their purpose.

Readers will be urged to try upon their own men folk recipes prepared for Chevalier and his ilk, the theory being that women who take little interest in foodstuffs may be drawn to the kitchen once more. Mrs. Phyllis Kraft Dunning and Miss Marjorie Deen, home economics specialists, will be in charge.

The some 700 stores through which the Syndicate Publishing Company distributes this magazine sell few foodstuffs, but usually there is a grocery store between Kresge's and the nearest movie theater. The new service is expected to make "talkie" devotees talk to the grocery clerk more often.

Financing Plan Established For Frozen Food Cases

A PLAN for financing the purchase by retailers of approved low-temperature display and storage cases for frozen package foods has been set up by the Commercial Credit Company, of Baltimore, Md., in cooperation with General Foods Corporation and its subsidiary, the Birdseye Packing Company, Boston, Mass. This is expected to remove one of the most serious obstacles in the way of market expansion for this type of product.

Commercial Credit Company proposes to provide a plan of deferred payments which will enable qualified dealers of quick-frozen foods to purchase the necessary equipment. Whether a single unit is involved or a $3,000 purchase, terms will be available that the dealer can meet out of earnings.

Probably a down payment of 25 per cent will be required, and thereafter monthly payments will be adjusted to suit individual conditions. While monthly payments probably will be placed at a minimum of $50, terms, particularly on large purchases, may be extended over periods as long as three years. In order to be sure that the rather rigid demands involved in the proper display and preservation of quick-frozen foods will be met, all equipment to be purchased under this new arrangement must have the approval of Birdseye Packing Company, Inc.

Considering the rapidity with which quick-frozen foods have gained public acceptance, officials of Commercial Credit Company estimate that within the next two years retailers will purchase $25,000,000 worth of equipment under the contract just concluded.

Dried Egg Duty Argued Before Commission

DOMESTIC producers of eggs and dried eggs supported their plea for a tariff increase from 18c. to 27c. a pound on imported dried products with evidence presented to the Tariff Commission, April 16 and 17, revealing that even at the present low market price for eggs it is impossible for them to meet the competition of Chinese dried egg imports. The 50 per cent increase in duty sought is the maximum permissible under the flexible tariff.

The most impressive argument made by domestic producers at the hearing before the Tariff Commission was that no great investment would be required to place domestic manufacture of dried eggs on a firm footing. The Commission was informed that there are many milk-drying plants located throughout the country that could be readily converted for this purpose and that the manufacture of dried eggs also could be carried on in many modern dairy plants by utilizing byproduct steam.

Great emphasis was placed by the domestic producers on their present plight. Dr. Earl W. Benjamin, representing Pacific egg producers, stated that current prices are the lowest on record because of the surplus caused by increasing importations of Chinese eggs. Dr. Benjamin said that hatching has been curtailed by 50 to 60 per cent. W. R. Ogg, representing the American Farm Bureau Federation, stated that the wholesale price of eggs at Shanghai is 5c. a dozen, as compared with a domestic production cost of 26c. per dozen estimated by Russell H. McDrew, representing Pacific Coast poultry organizations.

Importers contended that there is no justification for an increase in duty. H. M. Glenn, of Ellicott City, Md., a manufacturer of prepared flour, expressed the belief that it will be several years before domestic producers of dried eggs will be able to place a satisfactory product on the market.

Cherry Rate Maintained

The refusal of President Hoover as announced on April 7, to reduce duties on canned tomatoes and tomato paste and on cherries, sulphured or in brine, as recommended by the Tariff Commission, is regarded in Washington as placing him on record against scaling down the tariff on agricultural products, while permitting numerous reductions in rates on manufactured goods. Some weight is given to this interpretation of the President's action by his own statement to the effect that the Commission's investigation was necessarily based upon conditions obtaining before last year's disastrous drought and covered such a short period that further consideration by the Commission on the basis of 1931 crops is desirable.

President Hoover's refusal to accept the Tariff Commission's recommendation for a reduction in duty on maraschino cherries has caused much resentment among packers, confectioners, and the ice cream trade. The explanation that the Commission's investigation covered a period prior to the emergency created by last year's drought is regarded as untenable, inasmuch as its survey included 1930 as well as 1929. They point out that the crop of 18,000 tons last year was 1,000 tons larger than in 1929 and that in California a considerable proportion is regularly produced on irrigated land. The lower price in 1930 is attributed to larger production in both Oregon and California. The importers also argue that cost, and not selling prices, is the decisive factor in the matter.

The trade contends that there is no dependable supply of domestic cherries suitable for maraschino use, as the California fruit normally is a large cherry of tender texture that breaks down in processing.

The Commission has assigned for hearing on May 26 the application of importers, made by Senator Barkley, Kentucky democrat, for a reduction in duties on glue and inedible gelatin. The glue industry has been under practically continuous investigation since 1924.

Margarine in New Colors May Have Sales Test

MARGARINE of rainbow hue, supercharged with extra vitamins, is an experiment that may be tried out to extend the market. Frustrated by recent enactment of the law imposing 10c. per pound tax on yellow margarine made from palm oil, manufacturers are said to be giving serious consideration to adopting a new distinctive color for their product.

This may be red, green, amber—any color that is recommended by a study of the technical and psychological factors involved. Whether the public will respond to a spread for bread that is not of the traditional color is the question to which the margarine makers are seeking a definite answer. They may get it by marketing samples of other colors in one or more small communities.

In considering adoption of another color, the margarine manufacturers are adapting to their own purposes a scheme used against them in the past. At various times in the past state legislatures have passed laws, afterward declared unconstitutional, permitting sale of margarine only when colored pink, green, or other unnatural hues.

Marketing of the natural yellow palm or soy bean oil products may persist, despite imposition of the dime tax, but because of low butter prices there is no differential in favor of the tax-paid product. Manufacturers of artificially yellow-colored margarine never have been able to push their sales much above 15,000,000 lb. a year in the past.

Margarine richer in vitamin *A* and *D* content than butter, made by adding deodorized cod liver and other fish oils, vegetable oils, oils from beef liver and other substances, is being produced by certain manufacturers in Germany, Holland, and England. Domestic manufacturers now are engaged in research along this line.

Results of the 1929 distribution census for oleomargarine and other butter substitutes were released by the Census Bureau on April 23. The manner in which sales in this industry were made is tabulated below.

Sales by Manufacturers of Oleomargarine and Other Butter Substitutes, 1929

	Selling Value F.O.B. Factory	Percentage of Sales	Number of Plants
Total	$46,522,000	100	41*
Sales to manufacturers' own wholesale branches†	5,837,000	12.5	15
Sales from factories:			
To dealers—			
Wholesalers	24,803,000	53.3	33
Retailers	14,826,000	31.9	29
To industrial consumers	1,056,000	2.3	10

The sales made from factories amounted to $40,685,000. Of this amount, 11.6 per cent or $4,708,000, was made through manufacturers' agents, selling agents, brokers, and commission houses.†

*The total number of establishments engaged primarily in the manufacture of oleomargarine and other butter substitutes is 41. Inasmuch as some establishments sell to more than one type of customer, this total is less than the total of the figures shown below.

†This report does not cover the sales by manufacturers' own wholesale branches to wholesalers, to retailers, and to industrial consumers, nor does it cover the sales by these branches through manufacturers' agents, brokers, and commission houses.

TRADE NOTES

BEATRICE MEADOW GOLD DAIRIES has been organized at Galesburg, Ill., with a capital of $400,000. The organization is a subsidiary of the Beatrice Creamery Company and will handle a full line of dairy products.

CANADA DRY GINGER ALE, INC., has registered a great increase in volume of sales as a result of a recent 20 per cent cut in retail prices. Production capacity and sales force have been increased to meet the gain in volume.

GREAT WESTERN SUGAR COMPANY, Denver, Colo., will not recruit beet field labor in Colorado this year, it has announced, due to the reduced scale of wages proposed by growers in this section. The 1930 scale for this work was $23 per acre. The 1931 schedule offered by growers called for $18 an acre, which Great Western declares is too low. Estimates indicate that beet acreage in Great Western territory will be 35 to 50 per cent less than usual, on account of the $5.50 basic price for beets.

KELLOGG COMPANY, Battle Creek, Mich., will be permanently operated on a four-shift six-hour day, as a result of the success of the system established last December, according to Lewis J. Brown, president of the company. Mr. Brown said that the system had cut down overhead, increased production, increased the basic wage scale, and resulted in the employment of 20 per cent additional persons.

LOMEN REINDEER CORPORATION has established branch offices in San Francisco, Calif., and will act as distributing subsidiary for the Alaska Live Stock & Packing Company.

NEW ZANESVILLE PROVISION CO., Zanesville, Ohio, has been acquired at a trustee's sale by A. T. Rogge, R. S. Roberts, and M. L. Fisher, incorporated as the Zanesville Provision Company. The plant will be reopened with A. T. Rogge in charge.

PROCTER & GAMBLE COMPANY has completed plans for the acquisition of the Portsmouth Cotton Oil Refining Company, Portsmouth, Va. The plant at Portsmouth, Va., will now be enlarged to provide room for production of products of the parent and subsidiary companies.

PURITY CAKE COMPANY, Chicago, Ill., has merged with the Jersey Farms Baking Company, Detroit, Mich. The latter company also has plants in Brooklyn, Cohoes, N. Y., and Newark, N. J.

PERSONALS

W. DALE BOST, formerly chief chemist and director of production of the Orange-Crush Company, Chicago, Ill., has been elected president of the organization. Before joining the Orange-Crush Company in 1920, Mr. Bost served as chief chemist and assistant

W. Dale Bost

director of the Pacific Coast Division of the National Canners' Association. Mr. Bost is the inventor of the method by which a considerable portion of orange juice has been incorporated in the beverage to improve its flavor and nutrition value. NEIL C. WARD, one of the founders of the Orange-Crush Company and also a practical chemist of long experience, is the new chairman of the board.

DONALD FYFE BOWEY has been elected president of Bowey's, Inc., Chicago, Ill. Mr. Bowey succeeds his father, Charles F. Bowey, who died suddenly on April 7, after serving as president for 35 years.

E. JACK COULSON, associate biochemist in the nutrition department of the U. S. Bureau of Fisheries, has been assigned to the laboratory of the South Carolina Food Research Commission to carry on an investigation concerning the nutritive value of marine products.

E. R. JAGENBURG, formerly vice-president of the Crown Fruit & Extract Company, Inc., New York City, recently resigned.

FRANCIS POWELL, chairman of the board of the Anglo-American Oil Company, London, England, will serve as chairman of the International Sugar Council, the establishment of which was authorized by the World Sugar Conference at Paris several weeks ago.

W. HARVEY ROSS has been elected president of the Gunnison Sugar Company, Salt Lake City, Utah. William Wrigley, Jr., of Chicago, Ill., was re-elected chairman of the board.

WILLIAM M. STEELE, for many years vice-president and general sales manager of John F. Jelke Company, Chicago, Ill., has been made general sales manager in charge of margarine products for Durkee Famous Foods, a subsidiary of the Glidden Company. Mr. Steele will be located at the Chicago office.

T. J. TYNAN, formerly of the New York office of the New York Butchers' Dressed Meat Company, a subsidiary of Armour & Company, Chicago, Ill., has been appointed to the staff of Harry R. Mills, vice-president in charge of plant operations. In his new capacity, he will have charge of Armour & Company plants at Jersey City, N. J.; Pittsburgh, Pa.; Indianapolis, Ind.; Denver, Colo.; and Spokane, Wash.

OBITUARY

THOMAS CARSTENS, president of the Carstens Packing Company, Tacoma, Wash., and of the Pacific Oil Mills Company, of Seattle, Wash., died in Tacoma on March 18. He was 66 years old. With his brother, William, he founded the Carstens Packing Company in 1890. The company now has 50 branches throughout the Northwest.

MICHAEL O. ENGELSON, one of the most prominent figures in the New York State canning industry, died recently at his home in Williamson, N. Y. He was 68 years old. Mr. Engelson was one of the founders of the M. O. Engleson Company, treasurer of the Fruit Belt Preserving Company, president of the Wayne Cold Storage Company, vice-president of the Marion Canning Company, and a director in a considerable number of other organizations in that part of the state.

CYPRIEN GOUSSET, long a well-known figure in the confectionery industry, died on April 6, at his home in Allendale, N. J. Mr. Gousset, who was head of the Cy Gousset & Company for nearly 50 years, was 90 years of age. He has been retired for a considerable time.

DANIEL H. GRANDIN, founder and president of the D. H. Grandin Milling Company, Jamestown, N. Y., died at his home in New York City two weeks ago. He was 56 years of age.

CLAUDE E. GREGG, president of the Vincennes Packing Corporation, Vincennes, Ind., died suddenly on April 14. Mr. Gregg was president of the Indiana Canners' Association at the time of his death. At one time he had served as mayor of Vincennes.

CHESTER C. ISALY, general manager of the Isaly Dairy Company, operating plants in northern Ohio, died a few weeks ago. He was 44 years of age.

CARL KIEFER, president of the Carl Kiefer Machine Company, Cincinnati, Ohio, and inventor of packing and bottling machinery for food and chemical products, died on April 16. For twenty years he was associated with Rheinstrom Brothers Company, Cincinnati, food packers.

HAROLD L. MILLETT, of Chicago, relief plant manager for Swift & Company, died suddenly in Cleveland, Ohio, on April 19.

PHILIP O. SCHLEUSSNER, 53, first vice-president of the Roessler & Hasslacher Chemical Company, Inc., New York City, died on March 21 at his home in Stamford, Conn. He had been ill with bronchial pneumonia since last November.

NEW CONSTRUCTION

Bakery—Fehr Baking Co., 4104 Leeland St., Houston, Tex., awarded contract for the construction of a bakery at Beaumont, to C. J. Patterson Corp., 4050 Penn St., Kansas City, Mo. Estimated total cost $100,000.

Bakery—J. Vella, 182 Remsen Ave., New Brunswick, N. J., awarded contract for a 2 story, 30 x 100 ft. bakery to Hub City Construction Co., Livingston Ave., New Brunswick. Estimated cost $40,000.

Brewery—Cerveceria del Norte, Monterrey, Mexico, plans the construction of a brewery, 10,000 bbls. of beer per month capacity, including machinery and equipment. Estimated cost $300,000. Private plans. Some equipment purchased.

Brewery — F. & M. Schaefer Brewing Co., Kent Ave. and 10th St., Brooklyn, N. Y., plans the construction of an 8 story brewery and storage building. Estimated cost to exceed $100,000. Waldemar Mortensen, 103 Park Ave., New York, is architect.

Malt Storage Building—Canada Malting Co., 5200 St. Ambrose St., Montreal, Que., awarded contract for a 72 x 144 ft. storage building, to E. C. M. Cape Ltd., 620 Cathcart St., Montreal. Estimated cost $165,000.

Candy Factory—W. M. Hardie Co., 2260 East 69th St., Cleveland, O., awarded contract for the construction of a 6 story, 60 x 115 ft. candy factory at East 19th and Payne Sts. to S. W. Emerson Co., 1836 Euclid Ave., Cleveland. Estimated cost $200,000.

Cannery—Minnesota Valley Canning Co., Leseur, Minn., c/o D. Wall, 1020 Quellette Ave., Windsor, Ont., plans the construction of a cannery near Windsor. Estimated cost $1,500,000.

Canning Plant (Tomato)—J. C. Dunn, San Juan, Tex., plans the construction of a tomato canning plant at Muleshoe.

Creamery Plant — Louisiana Creamery Co., Inc., Baton Rouge, La., awarded contract for the construction of a creamery plant, including cold storage room, etc., to A. C. Stewart, Baton Rouge. $81,900.

Creamery—S. Palmer & Associates, Weatherford, Okla., are having preliminary plans prepared for the construction of a creamery. Estimated cost $25,000. Private plans.

Creamery—Saskatoon Dairy Poll, Saskatoon, Sask, plans the construction of a creamery on First Ave. Estimated cost $50,000.

Dairy Plant — Acme Farmers Dairy Ltd., Walmer Rd., Toronto, Ont., awarded contract for the construction of a 1 story, 60 x 150 ft. dairy plant at Hamilton to W. H. Yates Construction Co., 17 Main St. E., Hamilton. Estimated cost $60,000.

Dairy Plant—Bendora Farms, 18 Prospect St., Morristown, N. J., will not construct dairy plant. $40,000. Project abandoned.

Dairy Plant—Fuller Rancho Dairy, W. G. Noggle, Mgr., 5th St. and San Antonio Ave., Pomona, Calif., is having preliminary plans prepared for the construction of a 130 x 144 ft. dairy plant. Estimated cost $25,000. G. S. Underwood, 1404 California Reserve Bldg., Los Angeles, is architect.

Dairy Plant—Wittner & Saubendissan, South Bend, Ind., awarded contract for a dairy plant at 729 North Brookside Ave., to Harvey Hager, 1812 West Lafayette St., South Bend. Estimated cost $40,000.

Dairy Building—Pennsylvania State College, State College, Pa., plans the construction of a dairy building, etc. Estimated cost $940,000. Architect not selected.

Ice Cream Factory—Cleveland Ice Cream Co., D. H. Schlegal, Pres., West 47th St. and Train Ave., Cleveland, O., awarded contract for a 1 story, 70 x 150 ft. factory and garage building to W. Dunbar Co., 8201 Cedar Ave., Cleveland. Estimated cost $40,000.

Milk Distribution Plant Addition—Sheffield Farm Co., 524 West 57th St., New York, N. Y., plans addition to milk distribution plant at Hampton Bays, Long Island. Estimated cost including equipment $40,000.

Milk Receiving Plant—Kraft-Phoenix Cheese Co., Shirley, Ind., will build a milk receiving plant including refrigeration machinery. Estimated cost $40,000. Work will be done by owner's forces.

Milk Plant—Roberts Dairy, Sioux City, Ia., awarded contract for the construction of a 2 story, 160 x 175 ft. milk plant at West 9th and Omaha Sts. to H. Holtze, 2121 East 4th St., Sioux City. Estimated cost $165,000.

Cold Storage Unit—Highland Dairy Co. Ltd., 670 Ontario St., Toronto, Ont., plans the construction of a 35 x 50 ft. cold storage unit. Estimated cost $75,000.

Cold Storage Plant Addition—Bd. of Harbor Commissioners, Ferry Bldg., San Francisco, awarded contract for addition to cold storage terminal at Pier No. 46 to C. D. DeVelbiss, 369 Pine St., San Francisco.

Cold Storage Facilities—Duquesne Warehouse Co., A. J. County, Pres., Pittsburgh, Pa., subsidiary of Pennsylvania R.R., Broad St. Station, Philadelphia, plans the construction of a 10 story warehouse including dry and cold storage facilities at 10th and Penn Sts., Pittsburgh. T. J. Skillman, Philadelphia, is chief engineer.

Cold Storage and Refrigeration Warehouse—New York Central R.R., 466 Lexington Ave., New York, N. Y., will soon award contract for a 100 x 103 ft. cold storage and refrigeration warehouse on 14th St. Estimated cost $700,000. E. A. Dougherty, 466 Lexington Ave., New York, is designing engineer. J. M. Doorly, Engr. for New York Terminal Dist.

Ice Plant—Central Power & Light Co., National Bank of Commerce Bldg., San Antonio, Tex., will soon award contract for the construction of a 75 ton ice plant including machinery and equipment at Rio Grande City. Estimated cost $90,000. J. Marriott, National Bank of Commerce Bldg., San Antonio, is engineer.

Ice Plant—E. Held, 2209 Tremont St., El Paso, Tex., will build a 75 ton ice plant. Estimated cost $80,000. Work will be done by day labor. Equipment purchased.

Ice Plant—Morgan Utilities Co. Inc., Longview, Tex., has work under way on the construction of a 100 ton ice plant. Estimated cost $150,000. Most of work being done by day labor. Machinery purchased.

Ice Plant—Mountain Ice Co., c/o City Ice & Fuel Co., W. J. Sinek, V. Pres., 33 South Clark St., Chicago, Ill., awarded contract for the construction of a 175 ton ice plant, storage building, icing platform, 2,500 ft. long and 13 ft. wide on the Missouri Pacific R.R. tracks west of Blue River, to R. S. Blome Co., First National Bank Bldg., Chicago, Ill. Ice making machinery to Ball Ice Machine Co., 126 Chouteau Ave., St. Louis, Mo. $350,000.

Ice Plant—Shippers Co-Operative Ice Co., J. L. Price, Pres., Crystal City, Tex., will soon receive bids for construction of a 150 ton ice plant including 5,000 ton storage vault. Estimated cost $150,000. Private plans.

Ice Plant—West End Ice Co., 120 Chouteau Ave., St. Louis, Mo., awarded contract for the construction of a 1 story, 75 x 80 ft. ice plant at 3945 Easton Ave., to M. R. Rosenmeyer, 1548 South Vandeventer Ave., St. Louis. Ice making equipment let to Ball Ice Machine Co., 120 Chouteau Ave., St. Louis.

Ice Manufacturing Plant—Crystal Ice & Fuel Co., 129 East Mullan Ave., Waterloo, Ia., awarded contract for a 1 story, 80 x 120 ft. ice manufacturing plant to H. A. Maine Construction Co., 305 Marsh Place Bldg., Waterloo. Estimated cost $75,000. Equipment contract let to Vilter Mfg. Co., 2217 South First St., Milwaukee, Wis.

Ice Manufacturing Plant—Union Ice Co., 354 Pine St., San Francisco, Calif., awarded contract for a 1 story ice manufacturing plant at Watsonville to W. W. Williamson, 320 Market St., San Francisco. Estimated cost $100,000; also plans a 100 x 126 ft. plant on Brewster Ave., Redwood City.

Pre-Cooling Plant — Anaheim Co-Operative Orange Association, West Anaheim, Calif., awarded contract for the construction of a 1 story, 55 x 155 ft. storage and pre-cooling plant including refrigeration equipment, etc. on Lincoln Ave., West Anaheim, to H. A. Hamm, 2145 Sacramento St., Anaheim. Estimated cost $65,000.

Grain Elevator—Albany Port District Commission, P. G. Ten Eyck, Chn., Albany, N. Y., is having plans prepared for the construction of a grain elevator, 1,500,000 bu. capacity. Estimated cost $1,850,000.

Grain Elevator—Enid Terminal Elevator Co., Enid, Okla., awarded contract for addition to grain elevator, 1,000,000 bu. capacity, to Jones-Hettelsater Co., 600 Mutual Bldg., Kansas City, Mo. Estimated cost $250,000.

Grain Elevator—G. W. Green Co., Lethbridge, Alta., plans to rebuild plant recently destroyed by fire.

Grain Elevator—Kansas Elevator Co., c/o C. E. Robinson Milling Co., 9th and North Sts., Salina, Kan., awarded contract for the construction of a grain elevator 600,000 bu. capacity including 12 concrete tanks and seventeen interstise bins, 104 ft. high, 187 ft. long and 53 ft. wide to J. T. McDowell, 817 17th St., Denver, Colo. Estimated cost $70,000.

Grain Elevator—Riffe Bros. Co., Texhoma, Okla., awarded contract for the construction of a grain elevator, 250,000 bu. capacity to Chalmers & Borton, 720 Pioneer Trust Bldg., Kansas City, Mo. Estimated cost $25,000.

Grain Elevator Addition—Atchison, Topeka & Santa Fe Ry., 80 East Jackson Blvd., Chicago, Ill., awarded contract for addition to grain elevator, 4,000,000 bu. capacity at Argentine Station (Kansas City) Kan., to John S. Metcalf & Co., 105 West Adams St., Chicago. G. W. Harris, Chicago, is chief engineer.

Grain Elevator Addition — Chicago, Rock Island & Pacific R.R., La Salle St. Station, Chicago, Ill., and Simonds-Shields-Lonsdale Grain Co., Bd. of Trade Bldg., Kansas City, Mo., lessee, awarded contract for addition to grain elevator, 1,300,000 bu., including head house and conveyor system, also changes in dust collecting system and grain drying system to James Stewart Corp., 343 South Dearborn St., Chicago, Ill. Estimated cost $300,000.

Grain Elevator Addition—Midland Flour Milling Co., Bd. of Trade Bldg., Kansas City, Mo., is having preliminary plans prepared for addition to grain elevator, 400,000 bu. capacity at Blackwell, Okla. Horner & Wyatt, 468 Bd. of Trade Bldg., Kansas City, Mo., are engineers.

Grain Storage Tanks — United Mills Corp., H. E. Irwin, Pres., Grafton, O., awarded contract for the construction of twenty grain storage tanks to Jones-Hettelsater Construction Co., 600 Mutual Bldg., Kansas City, Mo. $100,000. Grinding equipment, crushers, bins and hoppers will be installed.

Grist Mill—Western Grist Mills Ltd., Moosejaw, Sask., has started excavation work for grist mill. Estimated cost $20,000.

Banana Ripening Building—Pennsylvania R.R., Pennsylvania Station, Pittsburgh, Pa., will soon award contract for the construction of a banana ripening building on Smallman St. Estimated cost $30,000. T. J. Skillman, Philadelphia, is chief engineer.

Fruit Curing and Packing Plant—American Fruit Growers, c/o C. C. McElwain, Mission, Tex., will soon award contract for the construction of a fruit curing and packing plant. Estimated cost $125,000. Private plans. Equipment will be required.

Fruit and Vegetable Terminal Building — Canadian National Railways, New Union Station, Toronto, Ont., and Canadian Pacific Railway Co., Windsor Station, Montreal, Que., plan the construction of a joint fruit and vegetable terminal building, including refrigeration system, etc., at foot of Bathurst St., Toronto. Estimated cost $2,000,000. No decision yet as to who will prepare plans.

Food Products Plant—Christie-Brown Biscuit & Co. Ltd., 192-202 King St. E., Toronto, Ont., awarded contract for the construction of a 135 x 525 ft. plant at Notre Dame Ave. and Myrtle St., Winnipeg, Man. to Hazelton & Walin Ltd., Electric Railway Chamber, Winnipeg. Estimated cost $1,000,000. Excavation started. Equipment includes air-washing plant, refrigeration and ventilating plant, biscuit-making machinery, etc.

Grocery Warehouse—S. M. Flickenger, 79 Perry St., Buffalo, N. Y., (wholesale grocers) will soon award contract for a 2 story, 150 x 160 ft. warehouse at Bailey and Clinton Sts. Estimated cost $100,000. G. S. Rider Co., Marshall Bldg., Cleveland, O., is architect.

Relish Factory—Oliver Relish Co., 115 South St., Newark, N. J., awarded contract for the construction of a 2 story, 98 x 130 ft. factory and office at Frelinghuysen Ave. and Noble St., to Drill Contracting Co., 889 Broad St., Newark. Estimated cost $40,000.

Sausage Factory—Boston Sausage Co., 157-163 Blackstone St., Boston, Mass., awarded contract for additions and alterations to factory, including two new steam houses and six smoke houses to W. C. Sharkey Co. Inc., 29 Ferry St., Boston.

Abattoir and Processing Plant—Saskatchewan Live Stock Pool, Saskatoon, Sask., plans the construction of an abattoir and processing plant. Estimated cost $70,000.

Packing Plant (Fish)—Bd. of Commissioners, City Hall, Seabright, N. J., plans the construction of a 1 story fish packing plant, etc., at Public Beach. Estimated cost $40,000. Architect not announced.

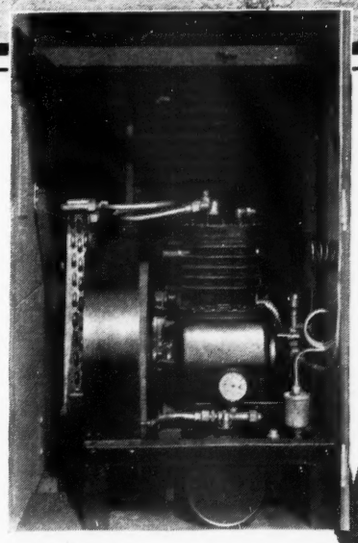
Packing Plant—Cleveland Provision Co., H. A. Schanz, Pres. and Treas., 2527 Canal Rd., Cleveland, O., is receiving bids for a 2 story packing plant at 3378 West 65th St. Estimated cost $250,000. P. Henchein, 59 East Van Buren St., Chicago, Ill., is engineer.

Packing Plant—John Duff & Sons Ltd., Brant St., Hamilton, Ont., will soon award contract for a 2 story, 75 x 150 ft. packing plant on Hillyard St. Estimated cost $100,000. Stewart McPhie, Sun Life Bldg., Hamilton, is architect. Complete packing and refrigeration equipment will be required.

Packing Plant—Essem Packing Co., 101 Beacon St., Lawrence, Mass., awarded contract for the construction of a 2 story packing plant to L. C. Cyr, 45 Melrose St., Lawrence. Estimated cost $40,000.

Sugar Refinery—International Sugar Co., 637 Battery St., San Francisco, Calif., plans the construction of a sugar refinery at Los Angeles. Estimated cost $2,000,000.

PROFITABLE NEWS *about*
Mechanical Refrigeration on
GENERAL MOTORS TRUCKS!



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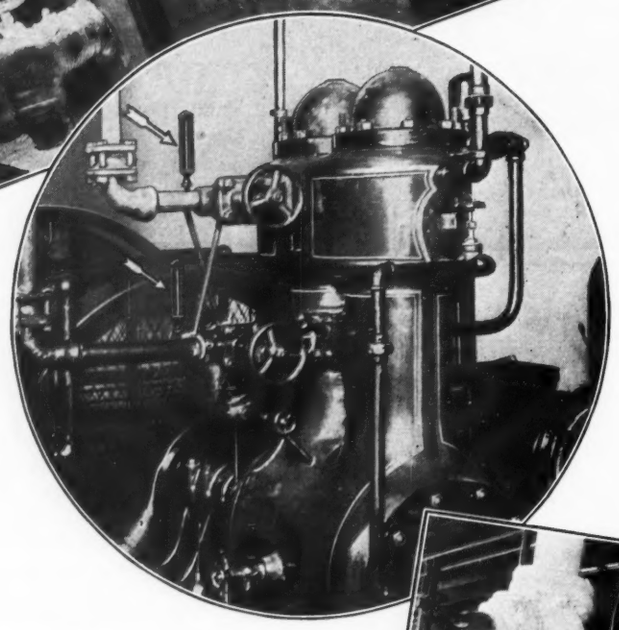
Pontiac, Michigan
Gentlemen: Please send a copy of "Mechanical Refrigeration on General Motors Trucks"—without cost or obligation.

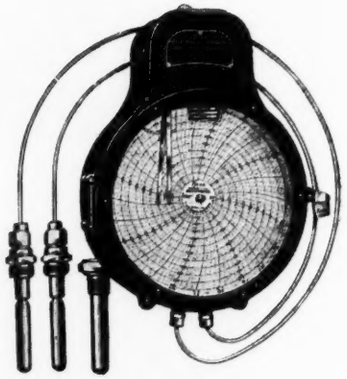
Name.....

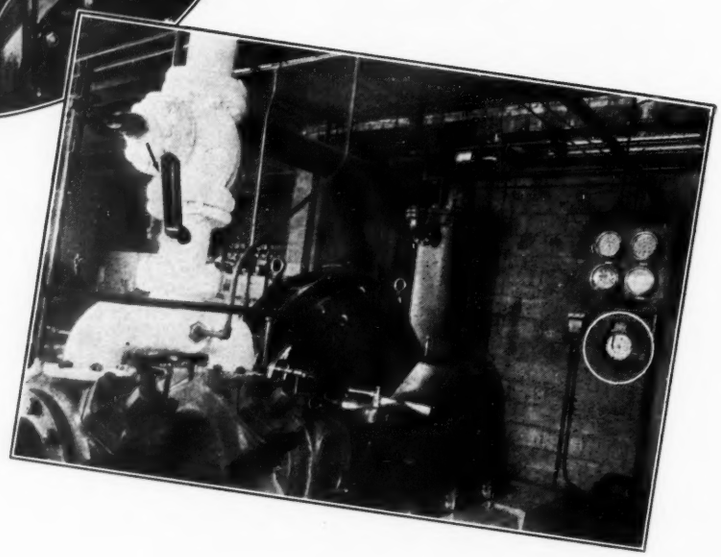
Address.....

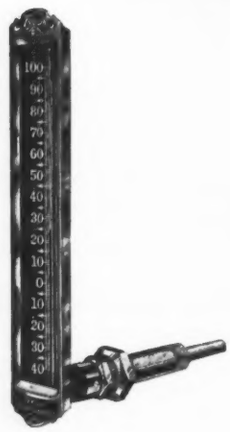
.....

New Refrigeration

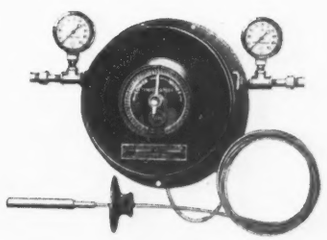








Developments Require *Tycos* Accuracy



AS REFRIGERATION climbs into an important position in food processing and temperatures are carried lower and lower, the need for instruments of *Tycos* accuracy becomes even more vital. ¶ There are *Tycos* Recording Thermometers with charts reading down to —100° F. You will probably not be interested in temperatures quite that low, but whatever your requirements, we shall be glad to suggest *Tycos* Instruments for the application.

Taylor Instrument Companies

ROCHESTER, N. Y., U. S. A.

In Canada, *Taylor Instrument Companies* of Canada, Ltd., *Tycos* Building, Toronto

● *Canning is but one of the many branches of the food industry in which Diamond Crystal Salt has opened the way to greater success. We should be glad to send you detailed information regarding the selection of the salt best suited to your own product*

The apple test showed a canner why pea sales had failed to increase

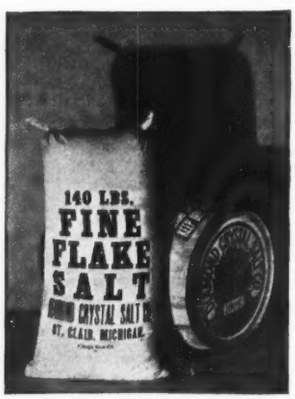
FOR years, a St. Louis canner had taken special pride in peas. His field men watched the contract acres like hawks. Invariably, the peas which went into the blancher were as tender as nature could make them. And yet, from year to year, sales instead of going up, began to sag. Retailers reported that repeat sales of this brand were almost nil.

At grocery stores, one of our salt experts bought several cans of these peas, and discovered that the peas had hardened. He called on the canner and persuaded him to have an analysis made of the salt being used. The chemist's report indicated that the hardening of the peas had been caused by salt impurities. But the canner was skeptical. "Do you mean to tell me," he asked, "that less than .1% of impurities can do such damage?"

"The apple test will answer that," said our salt expert. He cut an apple into quarters, then touched one of the slices to the salt that was then being used in the plant, and handed it to the canner. He tasted it, and made a wry face, for impurities in the salt gave the apple a bitter taste. After nibbling an unsalted piece of apple to clear his taste, he was handed another slice of apple which had been touched to pure salt, Diamond Crystal Salt. From that moment he was sold. For the purity of Diamond Crystal not only made itself apparent by noticeably mild and pleasant salt flavor, but greatly developed the flavor of the apple, and made the salted apple taste even richer and mellower than just plain apple.

Since this canner has been using Diamond Crystal Salt, his sales have been increasing, for now his peas remain soft and tender in the can, and the public has been quick to appreciate the difference. You too will find it worthwhile to safeguard the quality of your pack by using this pure salt. It keeps vegetables garden tender. It develops flavor.

It preserves bright, natural colorings. It is flaked and made by the exclusive Alberger process. Diamond Crystal Salt Company, (Inc.). *Bulk Department*, 250 Park Avenue, New York, New York.



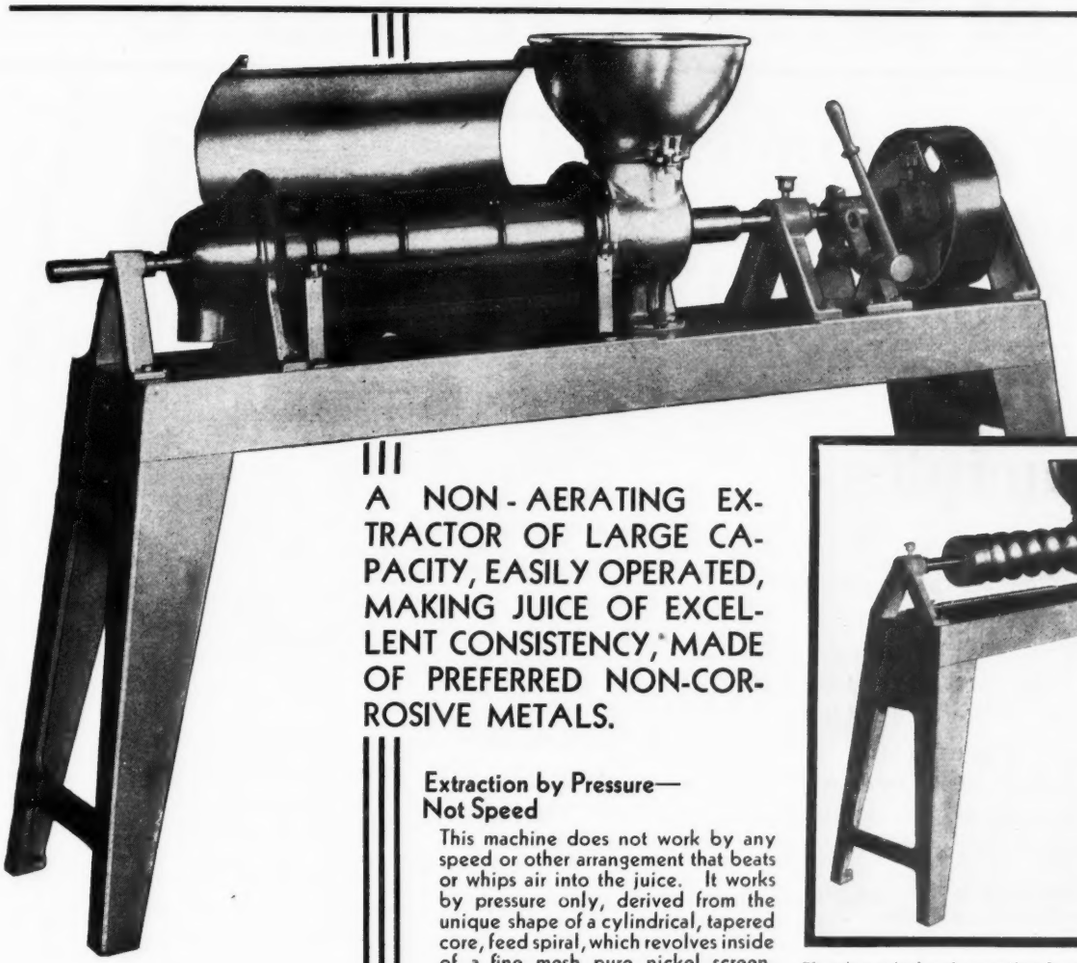
Year in, year out, Diamond Crystal Salt averages 99.9% pure — or better

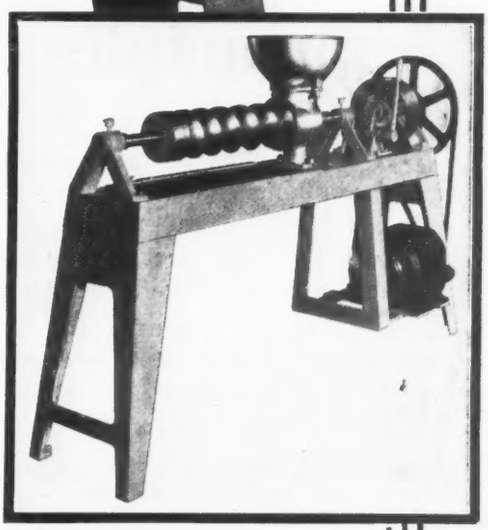
DIAMOND CRYSTAL SALT

A PRODUCT OF GENERAL FOODS CORPORATION

© 1931, G. F. Corp.

TOMATO JUICE EXTRACTOR





Showing spiral and mounting for motor drive.

A NON-AERATING EXTRACTOR OF LARGE CAPACITY, EASILY OPERATED, MAKING JUICE OF EXCELLENT CONSISTENCY, MADE OF PREFERRED NON-CORROSIVE METALS.

Thirty-three separate concerns, including the largest manufacturers of juice and those who make juice of best quality, used seventy-two of our extractors last season. Our three years' experience in making tomato juice equipment has enabled us to offer an excellent, improved 1931 model extractor. All new parts fit into machines used last season and are interchangeable.

Extraction by Pressure—Not Speed

This machine does not work by any speed or other arrangement that beats or whips air into the juice. It works by pressure only, derived from the unique shape of a cylindrical, tapered core, feed spiral, which revolves inside of a fine mesh pure nickel screen. The pressure increases as the tomatoes are carried forward and up from the deep grooves at the inner end of the spiral to the shallow grooves at the outer end. The juice is gradually squeezed out through the holes in the screen and the seeds, skins and cores are discharged at the end of the screw.

Large Yield—Juice of Excellent Consistency

The thin juice is extracted under the light pressure at the extreme inner end of the spiral, the heavier juice near the middle, and the pulp at the extreme outer end of the spiral, where the pressure is the greatest. Separate outlets under the screen, with a sliding separator, enables the operator to block off as much of the pulp as he desires, or it all can be put into the juice. This definite separation of the juice from the pulp insures the maximum yield of juice of any consistency desired. It is all done while the machine is in operation.

Completely Non-Aerating

The pleasing taste and high food value of tomato juice is destroyed by aeration. This machine is absolutely non-aerating. The speed is less than 200 R.P.M. The cover and discharge outlets fit close and snugly around the screen and are practically air-tight.

Pure Nickel and Allegheny Metal Parts

All parts in contact with juice are made of the best non-corrosive metals. The screen and screen frame are of pure nickel with screen openings of 20/1000 of one inch in diameter, 625 holes to the square inch. Cover and discharge outlet for juice and pulp are of Allegheny metal—machines both belt and motor driven.

American Utensil Co., 10 So. La Salle St., Chicago

"COOPERAGE"

—the container construction method based upon scientific principles

"Cooperage" is the art of constructing containers that conform to the *arch* principle:—multiple staves bound together against heads by external pressure to form a circular unit.

Whether employed to form wooden barrels, kegs, casks, or tubs, this method remains one of the finest engineering principles ever devised in containers.

The round construction, together with the curve of the bilge make Wooden Barrels easy to handle—to roll, guide, and upend. More important, they make barrels staunch to withstand rough handling. The impact of blows glance off the curved surface of wooden barrels.

Wooden barrels are economical—economical in first cost and when emptied of their contents can be readily sold for 50 to 75 percent of their original cost.

Thus Wooden Barrels, in tight or slack types, provide the very best container for food products of every kind, whether liquid, semi-liquid, dry, or powdered.

The Associated Cooperage Industries of America will give data regarding any packing problem upon request.

See the Wooden Barrel Exhibit in Booth 549, Thirteenth Exposition of Chemical Industries, Grand Central Palace, New York City, May 4th, to 9th, 1931.

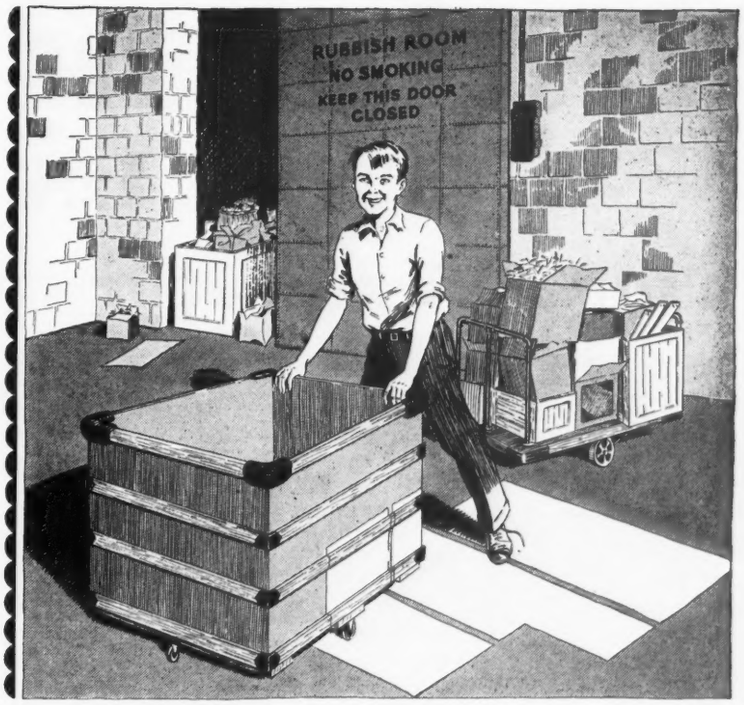
THE ASSOCIATED COOPERAGE INDUSTRIES OF AMERICA

Railway Exchange Building

ST. LOUIS, MISSOURI

WOODEN BARRELS

Cluttering up your plant — overflowing your Rubbish Room when business is good—inviting the birth of small fires, feeding the growth of big ones—why *tolerate* this wasteful nuisance?



Incineration means A *cleaner, safer* plant

MARKETS, bakeries, warehouses and food-products plants are finding that it *pays*—in sanitation, safety, floor-space and labor—to *burn up* their rubbish and production refuse.

For rubbish is a nuisance and a hazard. It fights against your clean-up work—hampers traffic in your plant—adds to your risk of accidents and fire—encourages lax standards of cleanliness and efficiency throughout your operation.

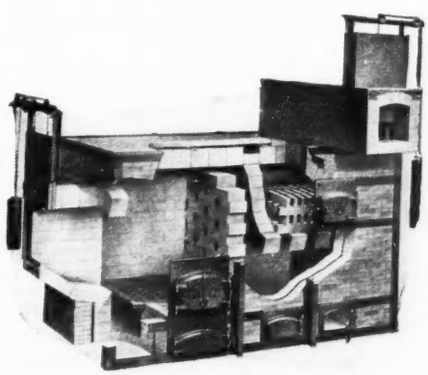
Modern incineration is the answer. Morse Boulger Destructors, built for the work by men who *know* waste-burning, are saving money and raising standards for many wide-awake concerns. May we send you detailed information?

Food Product Wastes—

Have you a special waste-disposal problem? Let us study it with you. Morse Boulger experience has included many surprising things. . . . Morse Boulger Destructors *today* are burning almost every conceivable kind of waste matter that is not actually liquid.

Heavy bakery garbage, canning refuse, spoiled food process products—all are being cleanly *burned,* without nuisance and without excessive cost. General accumulation of combustible rubbish usually furnishes all of the fuel. Operation is effective—economical—trouble-free, because Morse Boulger engineers know their business.

Correspondence is invited on any food-waste problem.



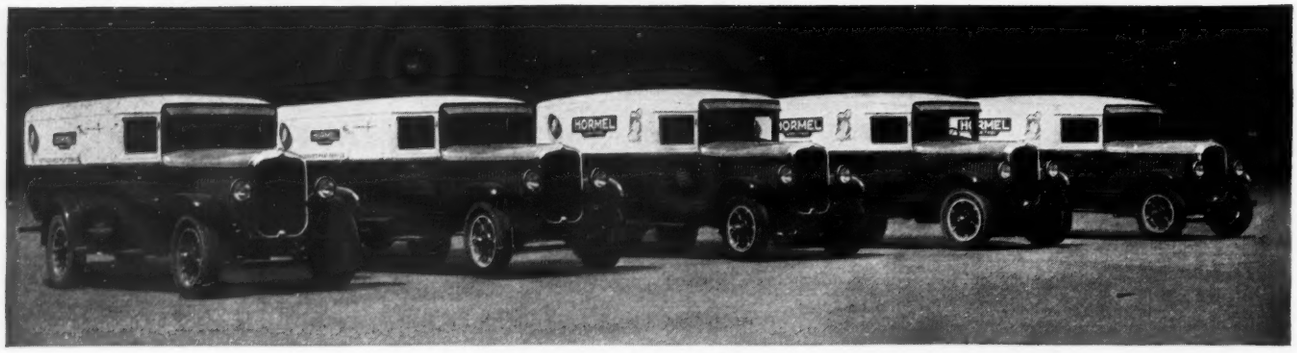
MORSE BOULGER DESTRUCTOR COMPANY
205F East Forty-Second Street, New York, N. Y.

Competent representatives everywhere for your convenience

HEAVY-DUTY INCINERATION
MORSE BOULGER DESTRUCTORS

J-269 F.I.

Balsam-Wool
INSULATION
for refrigerator cars and trucks



Truck bodies built by Cleveland Mfg. Co., Birmingham, Ala.

ELASTIC*
WIND-PROOF
FLEXIBLE

EFFICIENT
LIGHT-WEIGHT
DURABLE

Because of its elasticity, Balsam-Wool is not damaged by the twisting and jolting of moving vehicles. Long years of service in thousands of cars and trucks have firmly established the unexcelled efficiency and durability of Balsam-Wool—*true insulation

WOOD CONVERSION COMPANY

Mills at Cloquet, Minnesota

Industrial Sales Office: 360 No. Michigan Ave., Chicago, Illinois. *Branch Offices:* NEW YORK, DETROIT, SAN FRANCISCO

BALSAM-WOOL SEALED SLABS—*superior insulation for low temperature display cases, refrigerators and containers*

REFRIGERATION

LOW TEMPERATURE TECHNOLOGY, as we now know it, is possible largely through the inventiveness and energy of the equipment and supplies manufacturer. His contribution to compressor design and the science of heat exchange, his new and more effective use of insulating materials have been as important as the knowledge of the ways to utilize cold to advantage.

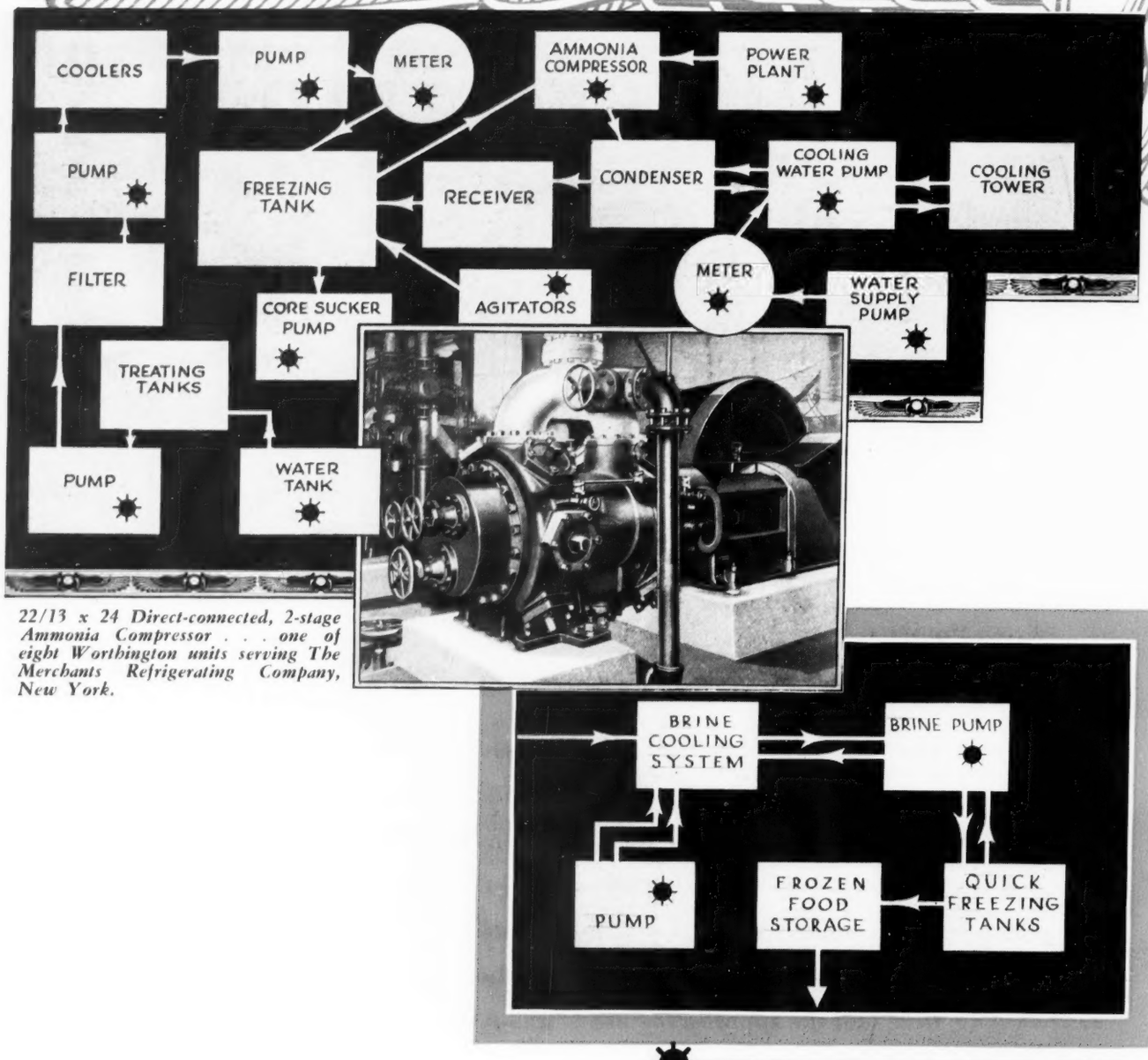
WITHOUT THE ECONOMIES of the newest equipment, users of refrigeration would not be able to operate profitably, and the new process of quick-freezing would be unable to compete with other forms of food preservation.

WHEN THE FOOD TECHNOLOGIST shall have determined additional uses of cold, the equipment maker will be ready with the proper units and supplies adapted to economical solution of the new problems. In the editorial pages of this issue the uses of low temperature are described by its users. In the pages that immediately follow are described the machinery, the insulation, and the supplies for use to attain those ends.

REFRIGERATION should be used more widely and more wisely.

THE PUBLISHERS

Modern Refrigeration Needs M



22/13 x 24 Direct-connected, 2-stage Ammonia Compressor . . . one of eight Worthington units serving The Merchants Refrigerating Company, New York.

At each step marked by this symbol, one or more of the following Worthington products can be used to advantage

PUMPS
All sizes...All Types
For All Services
Any Capacity...Any Pressure

CONDENSERS
and Auxiliaries

DIESEL ENGINES

GAS ENGINES

FEEDWATER HEATERS

WATER, OIL and GASOLINE METERS

MULTI-V-DRIVES

COMPRESSORS
Stationary and Portable

ROCK DRILLING EQUIPMENT
Rock Drills

Automatic Heat Treating Machines

Forging Furnaces

Drill Steel

Accessories

CHROMIUM PLATING

Literature on Request

eeds Met by Worthington Equipment

Refrigeration and quick freezing are fields where the traditional performance ability of Worthington equipment has had an exceptional opportunity to prove itself.

Far-seeing manufacturers have appreciated the dependableness offered by Worthington products and have capitalized it to their own advantage . . . as a safeguard of uninterrupted plant operation.

And, along with dependable performance, they have secured economies that have boosted their margins of profit . . . economies resulting from minimum power and lubrication requirements and from extended periods of operation between inspection and maintenance jobs.

Many of the largest and most successful plants have installed Worthington Ammonia and Carbon Dioxide Compressors, as well as Worthington Brine Circulating and General Service Pumps, Condensers, Meters, Multi-V-Drives, and other Power Service Equipment.

Back of the successful operation of Worthington products is a designing and manufacturing experience dating to the pioneer days of the refrigeration industry . . . forty years for compressors, seventy years for meters, and ninety years for pumps.

Worthington service is projected through district offices and representatives in twenty-four cities in the United States and in leading centers throughout the world. At each point you will find qualified engineers ready to analyze your problems and to show you where and how *you* can use Worthington products profitably.

Worthington Ammonia Compressors are sold in the United States exclusively by The Carbondale Machine Company, Carbondale, Penna., and in Canada exclusively by The Canadian Carbondale Company, Ltd., Montreal, Quebec.

WORTHINGTON PUMP AND MACHINERY CORPORATION

Works: Harrison, N. J. Cincinnati, Ohio Buffalo, N.Y. Holyoke, Mass.

Executive Offices: 2 Park Avenue, New York, N.Y.

GENERAL OFFICES: HARRISON, N. J.

District Sales Offices and Representatives:

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BOSTON	CINCINNATI	DENVER	HOUSTON	NEW ORLEANS	PITTSBURGH	SALT LAKE CITY	TULSA
BUFFALO	CLEVELAND	DETROIT	KANSAS CITY	NEW YORK	ST. LOUIS	SAN FRANCISCO	WASHINGTON

Branch Offices or Representatives in Principal Cities of all Foreign Countries

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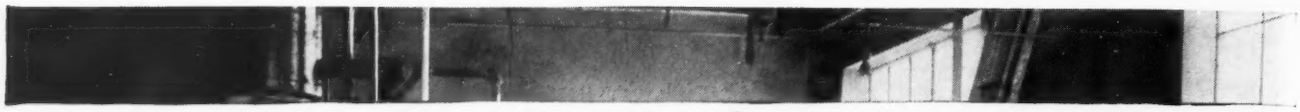
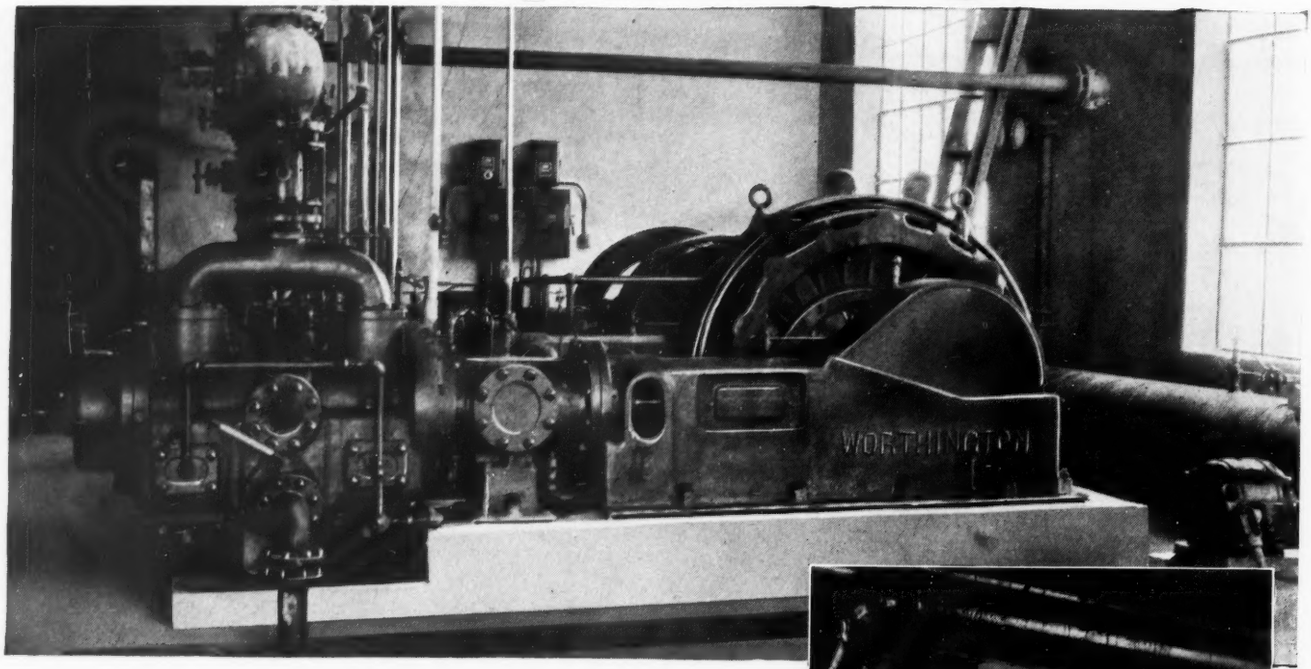
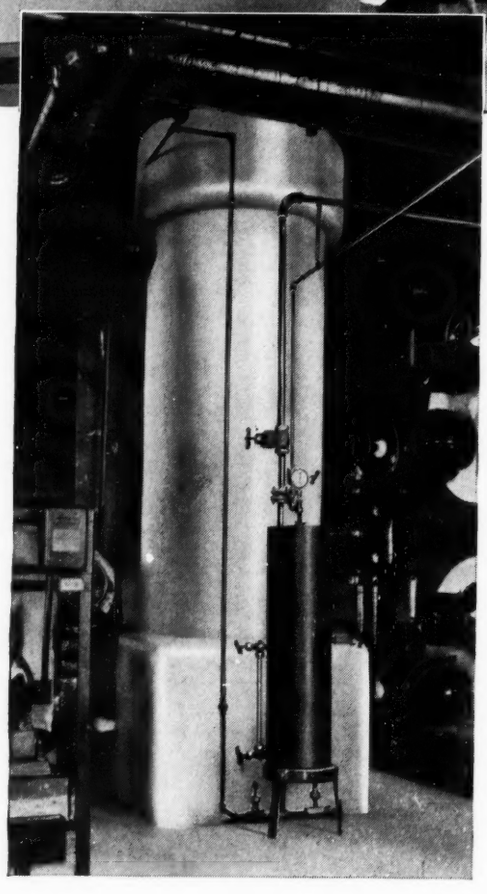
WORTHINGTON



Economy in quick freezing assured



with Carbondale two-stage, multiple effect refrigeration



10,000,000 lbs. of frozen fish. Cold storage, for preserving the fish during distribution. All these loads are carried economically by the Carbondale Compression Refrigerating System at New Jersey Ice and Cold Storage Co., Brant Beach, N. J.

15°F below zero and less must be maintained for freezing fish, and is, with a great saving in power cost by means of the two stage Worthington Compressor. By means of the multiple effect principle, ice is frozen with the same compressor, with practically no increase in power consumed.

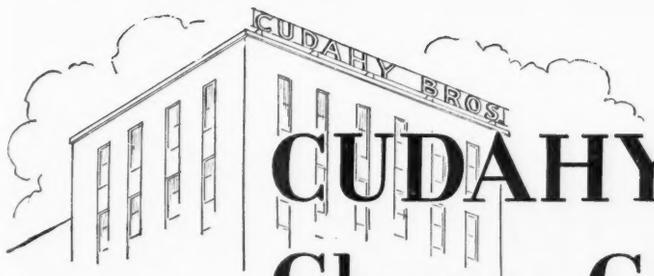
This installation is truly typical of Carbondale Engineering. There has been no compromise with efficiency. The system precisely suited to the job was installed. For the manufacturing process . . . air conditioning . . . food preservation . . . or the making of raw water ice, you will find Carbondale's intimate knowledge of refrigeration extremely helpful. The service of experienced engineers is freely offered.

THE CARBONDALE MACHINE COMPANY
CARBONDALE, PA. *Branches in principal cities*

Carbondale Refrigeration

ABSORPTION AND COMPRESSION AMMONIA CARMACO SYSTEMS AND CO_2 COMPRESSION SYSTEMS

CARBONDALE AMMONIA COMPRESSION REFRIGERATING SYSTEMS USE WORTHINGTON "FEATHER VALVE" COMPRESSORS



CUDAHY BROTHERS Choose CORKBOARD *for Quick-Frozen Meats*

Packing company calls on Armstrong to insulate low temperature rooms . . .

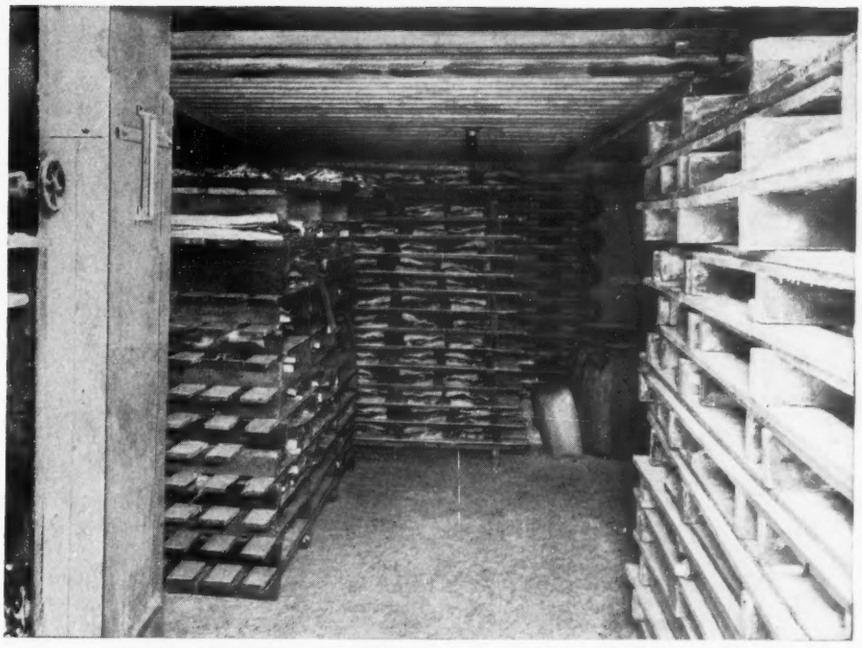
MEATS quick-frozen at fifty degrees below zero. Frigid temperatures that must be maintained. What insulation can satisfy these exacting demands? "Armstrong's Corkboard," says the Cudahy Brothers Packing Company.

The Cudahy plant at Cudahy, Wisc., illustrates the important part corkboard plays in quick-freezing. Careful plans marked the construction of the new quick-freeze rooms. Armstrong engineers were consulted on insulation. After a study of all the conditions, these engineers recommended 12 inches of corkboard to do the job.

This plant is now operating at capacity in the production of frozen meats. In just a short time Armstrong's Corkboard has once again demonstrated its effectiveness. Because it resists moisture—because it is structurally strong—permanently reliable. Installation by Armstrong's Construction Department provides added assurance that Armstrong's Corkboard will give extra service.

Armstrong's (A) Product

Armstrong engineers have been working in the low temperature field for more than a quarter of a century. To centralize their experience a Frozen Foods Development Committee has been formed. This committee will be glad to help you with your refrigeration questions. Their advice is at your disposal—just drop a line to the Frozen Foods Development Committee, Armstrong Cork & Insulation Co., 948 Concord Street, Lancaster, Pa.



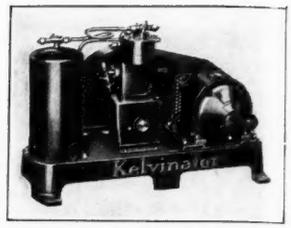
CUDAHY'S QUICK-FREEZING ROOM *carried at 50° below zero, is insulated with 12″ of Armstrong's Corkboard.*

Armstrong's Corkboard Insulation

The Standard Insulation for All Refrigeration

The door is always open

AT REFRIGERATION HEADQUARTERS!



Kelvinator offers 30 different condensing units—a type and size for every refrigeration need.

For seventeen years, manufacturers from many different industries have come to Kelvinator with their refrigeration problems.

Kelvinator engineers have welcomed them and their problems. The door at Refrigeration Headquarters has always been open—because Kelvinator Engineers are, by experience and by choice, pioneers.

Kelvinator engineers are keenly appreciative of the tremendous possibilities for electric refrigeration. Likewise, they realize the responsibility the future imposes—*and accept it*—eagerly, with full assurance they can, in the future, work hand in hand with manufacturers, with the same brilliant success they have achieved in the past.

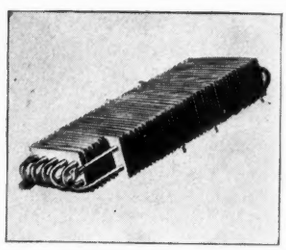
Manufacturers with refrigeration problems who are interested in *better refrigeration for less money* are invited to come direct to Refrigeration Headquarters. Undoubtedly, Kelvinator engineers can work with them—successfully.

KELVINATOR CORPORATION
14271 Plymouth Road, Detroit, Michigan

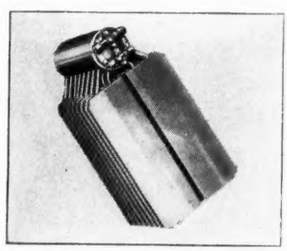
Kelvinator of Canada, Limited, London, Ontario
Kelvinator Limited, London, England

(282)

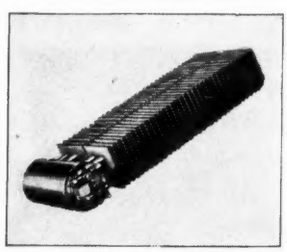
Kelvinator



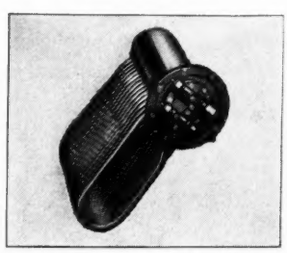
The new Kelvinator Cross Fin Coil is the most revolutionary development in commercial refrigeration.



Years of satisfactory service have proved the efficiency and economy of Kelvinator Deep-Fin Coils.



Kelvinator Flooded System Cross Fin Coils give more refrigeration, faster refrigeration than any other commercial coil.



The Kelvinator Line includes the Submersion type coil in sizes for all liquid cooling requirements.

JUST PUBLISHED... AND FREE!

THIS BOOK OF IMPORTANT FACTS FOR OWNERS OF REFRIGERATED TRUCKS

How can the costs of food refrigeration be reduced? How has a leading food product manufacturer eliminated spoilage? Why does truck body insulation sometimes fail to insulate? What important new facts have been discovered about the insulation of refrigerated trucks? How can a truck owner be sure of getting maximum efficiency from his refrigeration investment? How can perishables be protected without heavily taxing payload capacity? How can a truck be insulated without endangering food flavors?

These and many other vital questions that food product manufacturers and distributors are asking, are answered in a remarkable new book called, "Protecting the Payload." This book is packed full of valuable information that every person or concern interested in the transportation of food products should know. It is free. Just mail the coupon for your copy.

haircraft INSULATION

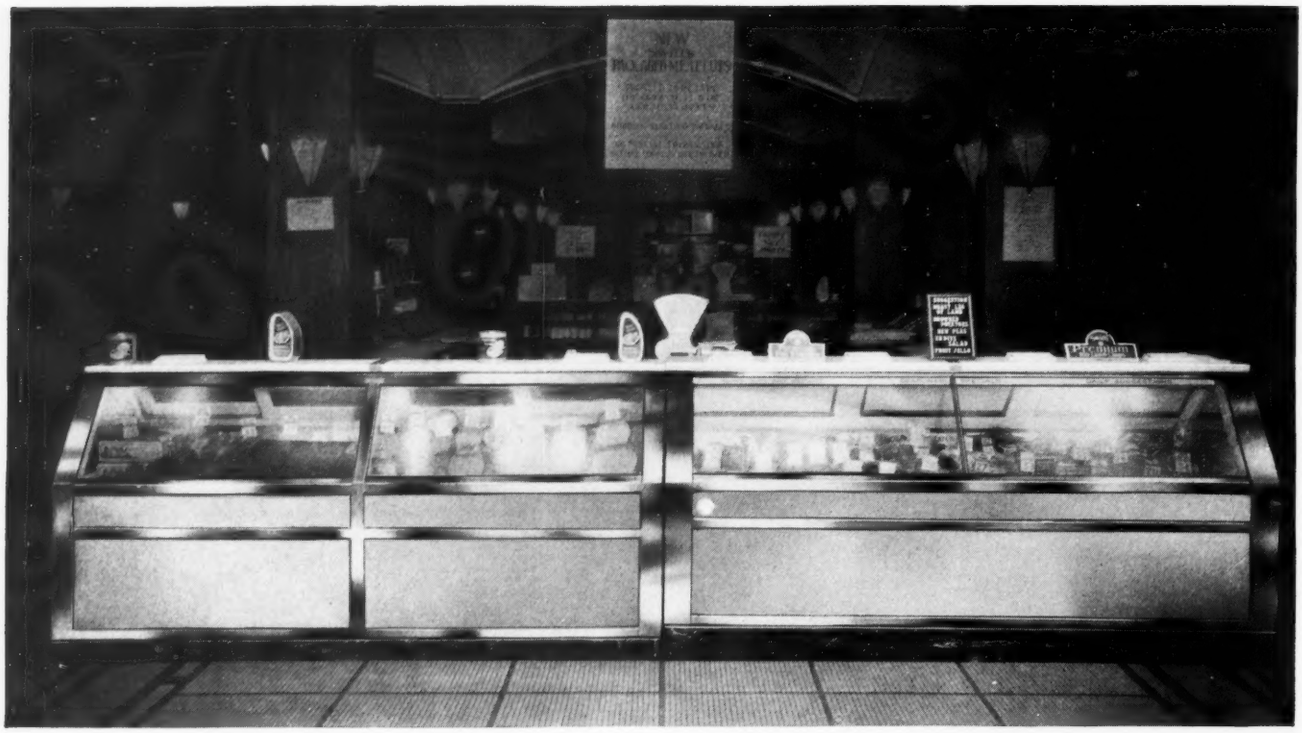
MAIL THIS

INSULATION DIVISION, WILSON & CO.
4100 South Ashland Avenue, Chicago, Ill.
Please send me free, and without obligation, a copy of the new book, "Protecting the Payload."

Name .....

Address .....

City ..... State .....



Installation of Monel Metal display cases in a large Chicago store. The case at the left is a typical above-freezing counter, while the case at the right is a zero temperature unit for displaying frozen foods.

MONEL METAL *Display Cases*

...the modern setting for your Frozen Foods!

CHAIN STORE executives agree that good display is of prime importance in successfully merchandising the new frozen foods. To swiftly educate the public to the advantages of these modern products requires display equipment that possesses distinctive eye and appetite appeal. Such equipment must always be modern and inviting. It must be easy to keep clean and sanitary. It must retain its original attractiveness for long periods under severe service.

Monel Metal display equipment is the answer to all these requirements. Its crisp, silvery attractiveness appeals instantly to the most fastidious customer. It is easy to clean and keep clean because Monel Metal cannot rust and is extremely resistant to corrosion. Monel Metal is safe to use inside as well as outside the cabinet because its smooth, close-grained surface does not retain food odors. Solid as sterling...strong as steel, with no coating to wear off, this modern Nickel alloy keeps its gleaming beauty through years of hardest service.

Leading manufacturers are now making Monel Metal display equipment for frozen foods. Ask us to send you their names.

The fascinating story of Monel Metal—its properties and uses—is told in a two-reel motion picture film now available for free distribution.

SEND FOR FREE BOOKLET "THE CASH VALUE OF APPEARANCE"

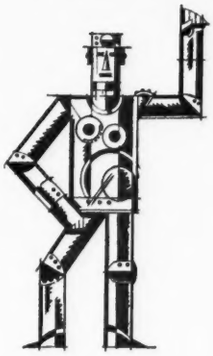
Monel Metal is a registered trade mark applied to a technically controlled nickel-copper alloy of high nickel content. Monel Metal is mined, smelted, refined, rolled and marketed solely by International Nickel.

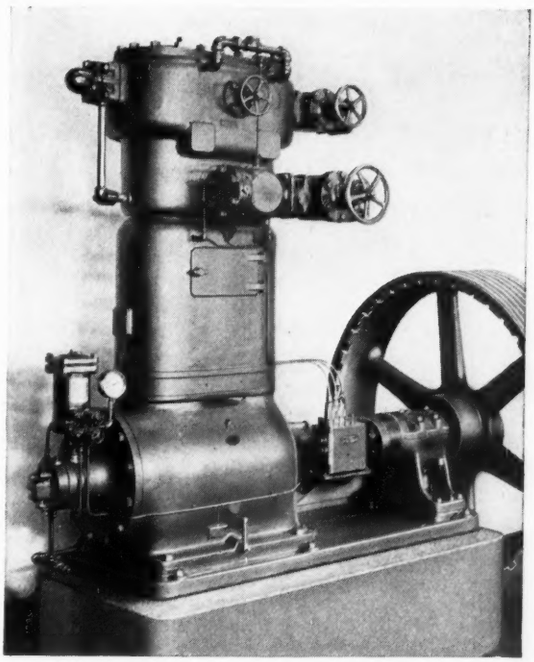
MONEL METAL

INCO MONEL METAL

THE INTERNATIONAL NICKEL COMPANY, INC., 67 WALL STREET, NEW YORK, N. Y.

Faithful Robot of the Food Industries





The York Booster Compressor, used in conjunction with the York Ammonia Liquid Circulating System, is an economical dependable source of low temperatures.

In developing this new Ice Age of Food Production . . . quick freezing of fish, game, meats and fruit . . . the Food Industries have been substantially aided by York Refrigeration . . . faithful robot in the production of the low temperatures needed.

The York Patented Ammonia Liquid Circulating System is daily producing temperatures as low as minus 60 degrees Fahr. It is producing these temperatures not expensively, but with economy.

For example, substantial savings in power result from the higher operating suction pressures combined with the unique feature of keeping the entire evaporating surface continuously wetted by ammonia.

Further economies are provided by the absence of static pressure on the liquid ammonia within the evaporator. A constant temperature and pressure exists throughout the evaporating coil surface. The York System is the only one having this very desirable characteristic.

Ever since mechanical refrigeration has been used in food preservation and production, York has been closely identified with the Food Industries. As a result York has thorough experience in refrigeration as applied to these industries. This experience is available to you through the nearest of York's 71 conveniently located direct factory branches. A York engineer is at your service to discuss your own particular problems.

YORK ICE MACHINERY CORPORATION, YORK, PENNSYLVANIA

YORK
REFRIGERATION

ICECO$_2$

...THE NEW SOLID CARBON DIOXIDE STEPS TO THE FRONT

ICECO$_2$—trade name for Solid Carbon Dioxide produced by the Carba process—steps to the front to change a nation's idea of refrigeration.

Brought to this country through the exclusive rights owned and controlled by the International Carbonic Engineering Company, this amazing process has proven its great efficiency and economy.

Already two great companies, licensed by International, are now successfully producing **ICECO$_2$** of the highest quality and at production costs heretofore thought impossible to attain.

ICECO$_2$ brings a new standard of economy and efficiency to modern refrigeration and promises an unlimited assistance to the food industry as it stands on the threshold of a great change.

MICHIGAN ALKALI CO.
Chicago New York Wyandotte, Mich.

MATHIESON ALKALI CO.
New York Saltville, Va.

LICENSEES PRODUCING ICECO$_2$

INTERNATIONAL CARBONIC ENGINEERING COMPANY
KENNETT SQUARE, PENNSYLVANIA

The sharply increasing production and distribution of **ICECO$_2$** now makes practical and possible for general use all the products covered by International patent holdings.

International is now ready to license manufacturers of refrigerating equipment for the handling of frozen foods, for wholesale, retail and domestic use—display cases, storage units, domestic boxes, shippers and equipment covering every phase of Solid Carbon Dioxide refrigeration.

Holders of International licenses automatically become members of a world-wide organization composed of the foremost Solid Carbon Dioxide Engineers now operating Carba process plants in 17 countries.

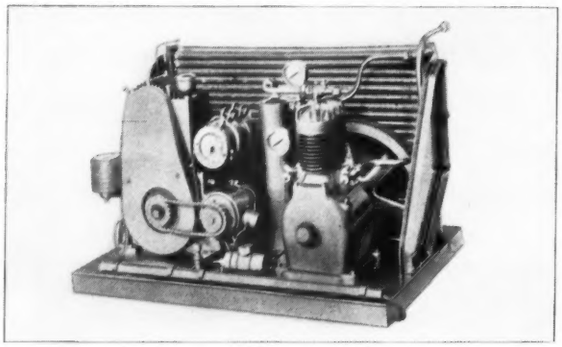
International invites inquiries from manufacturers desirous of learning the wide range of its patented equipment and what it means to the refrigeration industry.

A PARTIAL LIST OF OTHER CARBA PLANTS—

Bern, Switzerland
Zurich, Switzerland
Liege, Belgium
Brussels, Belgium
Paris, France
Hamburg, Germany
Wurtzen, Germany
Madrid, Spain
Milan, Italy
London, England
Manila, Philippine Islands
Tokio, Japan

MECHANICAL REFRIGERATION *FOR TRUCKS AND TRAILERS*

UNIFORM BODY TEMPERATURES



LOW OPERATING COST

COMPLETELY CONTAINED REFRIGERATING UNIT OPERATED INDEPENDENT OF TRUCK MOTOR

THERMOSTATICALLY CONTROLLED TEMPERATURES

TRAILER FOR TRANSPORTING FRESH MEAT AND PACKING HOUSE PRODUCTS EQUIPPED WITH SAFETY AUTOMATIC REFRIGERATING UNIT

NEW ILLUSTRATED PAMPHLET DESCRIBING THE SAFETY AUTOMATIC REFRIGERATING MACHINE WILL BE FURNISHED UPON REQUEST

SAFETY REFRIGERATION, INC.
75 WEST STREET
NEW YORK, U. S. A.

INSTANTANEOUS CHILLING

. . . . a brief outline of advantages which accrue to users of Vilter-planned "Sharp Freeze" Systems . .

In Ice-making and Refrigerating, one name looms great... Vilter, pioneer of a great industry.

For fifteen years Vilter has installed for customers in all parts of the world, low temperature systems similar to those which have recently attained widespread popularity.

The younger generation, overlooking achievements of the past, is prone to discuss the sharp freeze (or "instantaneous chilling") as a very new development. Yet Vilter has an experience in this "new" field covering a decade and a half.

Just what this experience means to any industry contemplating the installation of an instantaneous chilling system is summarized in the data and findings gathered during fifteen years of first-hand study of actual, operating installations —proved far beyond theory.

To all it must be apparent that such a background can have but this single result:

The appointment of Vilter to engineer, design, fabricate and erect an instantaneous chilling plant of any size is a virtual guarantee that it will function perfectly, in accord with predetermined figures.

* * * * *

Among the many reasons why Vilter Instantaneous Chilling Systems are preferred by users in all sections of America and abroad are these outstanding advantages:

1 . . . Defrosting without hot gas connections—a revolutionary method which saves raising room and coils temperatures approx. 90 deg., eliminates extra connections, valves, fittings, etc., and banishes rust, wet floors, etc., from the plant.

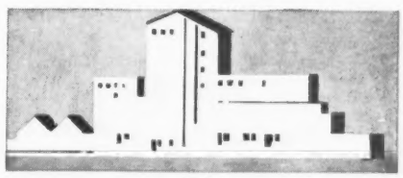
2 . . . Ordinary ammonia receiver capacity makes unnecessary the installation of oversize equipment, thus effecting a considerable saving on cost.

3 . . . Eliminates extra (additional) horsepower required by ammonia circulating pumps—has no accumulators, no liquid pumps; another great saving on initial installation cost.

4 . . . Operates with a suction gas of MINUS 60 deg. F. (low side). Coil system free from oil collection; no liquid slugs back to the compressor.

5 . . . As an instance of the efficiency of the Vilter Instantaneous Chilling System: In a typical installation, there is an average DAILY quick freeze of 125,000 lbs. of pork (whole hams and bellies) from PLUS 40 deg. F. to MINUS 40 deg. F. . . . *in twelve hours!*

* * * * *



The Engineering Department of this organization will be glad to cooperate with you or your engineers to evolve a quick freeze (instantaneous chilling) system adapted to your individual plant requirements.

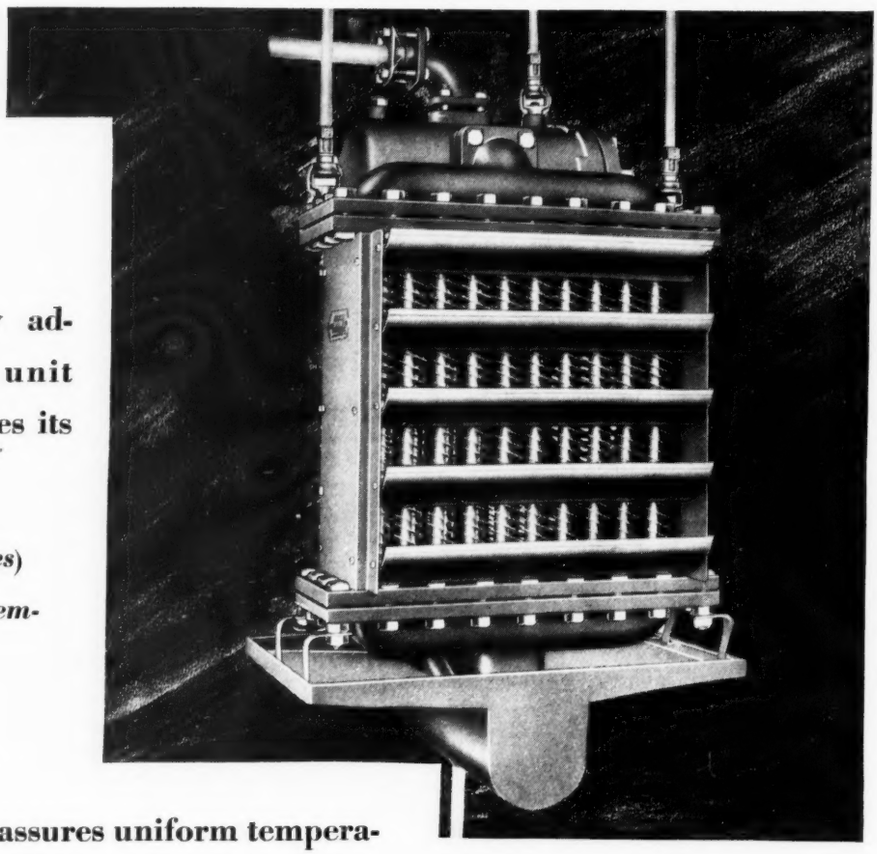
Write for details without obligation. Or send your blueprints for checking and quotations.

Bulletins, data and special reports on any phase of refrigeration may be had gratis . . . for the asking.

97-30

THE VILTER MANUFACTURING CO.
2115 SO. FIRST ST. :: MILWAUKEE, WIS.

NEW GRINNELL *Unit-Cooler*



WHAT a revolutionary advance, when this little unit replaces more than ten times its weight in pipe coils.

Saves space (20x42x23 inches)

More constant uniform low temperature.

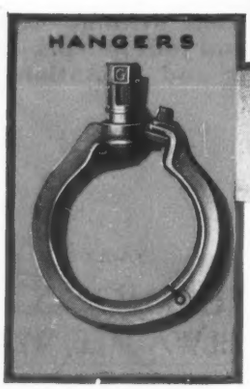
No over-frosting troubles.

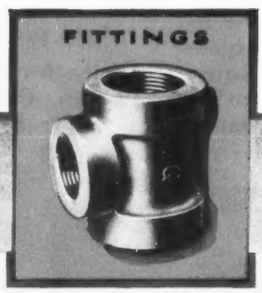
Greater rapidity of cooling.

Complete circulation of air assures uniform temperature in all parts of the room, from floor to ceiling, around and behind closely stored products.

The new Grinnell Unit Cooler automatically defrosts itself in cycles. Therefore it cannot lose efficiency by over-frosting.

ALL THESE GRINNELL PRODUCTS WILL SAVE





Pipe fittings, cast and malleable, perfectly threaded, accurately machined and rigidly inspected. Pipe hangers adjustable after the pipe is up. Reduce installation costs and maintenance expense.

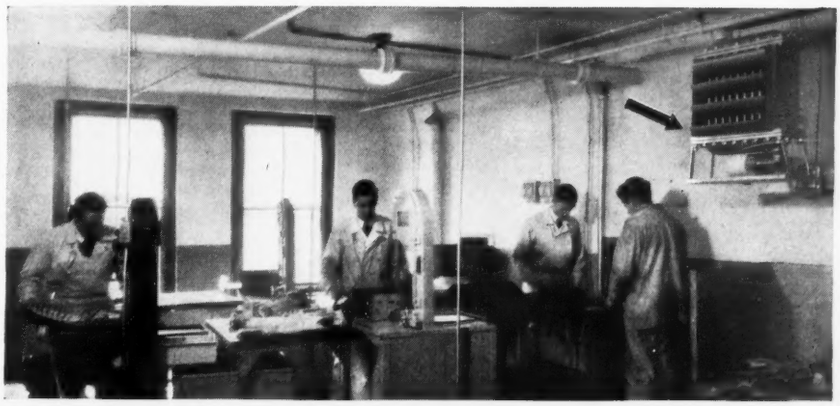
This trap, with the famous Hydron Bellows, will operate a radiator for a lifetime without repairs.

The famous Quartz bulbsprinkler head. In most cases sprinklers will reduce insurance expense from 50 to 90 percent.

Where air dryness adversely affects processes, large savings are made by our humidification equipment.

in Meat Packing Plants

for instance



*Cutting Room for Batchelder, Snyder, Dorr & Doe Co.— "Birdseye Frosted Foods"— *(BRINE UNITS)*

*Packing Room for Batchelder, Snyder, Dorr & Doe Co.— "Birdseye Frosted Foods"— *(BRINE UNITS)*

* *The Liquid Level Control is not used with this type of Grinnell Unit Cooler.*

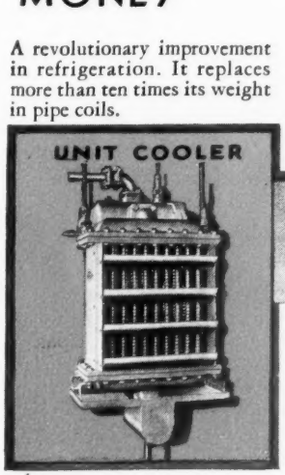
The *Liquid Level Control*, used with the evaporator type of cooling and refrigerating units, automatically holds refrigeration liquids at any predetermined level, thereby greatly increasing efficiency and capacity over the so-called direct expansion type. No leakage to compressors is possible. An authoritative bulletin explains other important advantages of the Grinnell Unit Cooler for storage rooms, factories, bakeries, etc. Send for it.

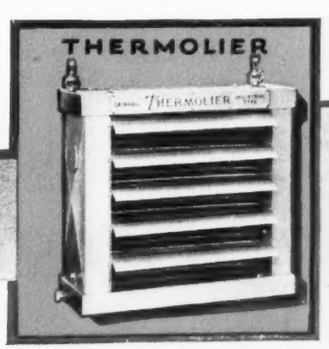
GRINNELL COMPANY INC.

Executive Offices: Providence, R. I., *Branches in all Principal Cities*

MONEY

A revolutionary improvement in refrigeration. It replaces more than ten times its weight in pipe coils.





This remarkable Unit Heater is a better and cheaper means of heating industrial and commercial buildings. Heating systems can usually be modernized almost over-night, with a tremendous saving on fuel.

Pipe fabrication, lap joints, pipe bends, forged hangers and welded headers comprise the Triple XXX line for Super Power work. By modernizing to use high temperature steam your yearly savings will often run to five or six figures.

How this new use of refrigeration saves SPACE and COST in storing FROZEN FOODS

★

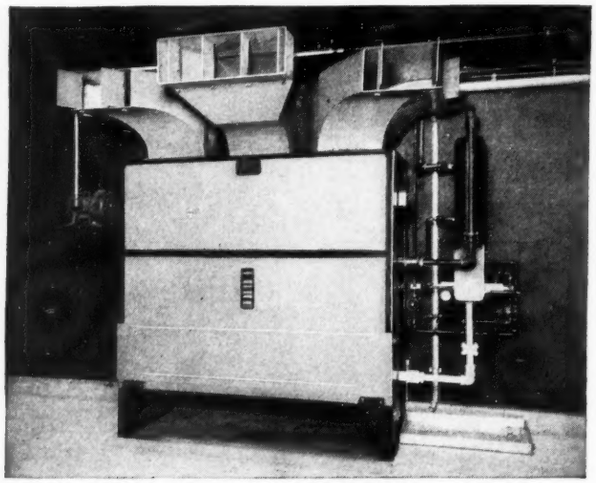
Cold Diffusers eliminate bunkers and wall coils, protect products with active, uniform cold

ALMOST as important to the food industry as quick-freezing itself is Cold Diffusion. This new method of applied refrigeration does away with the old bulky bunkers and wall coils, gives you the added space for storing frozen foods and other perishable products, and reduces the construction cost of storage rooms.

In one case—that of Preserves & Honey, Inc., of New York—Carrier B-K Cold Diffusers made room for a whole extra tier of barrels for storing the berries and fruit used in making preserves. And this is by no means an exception. Today scores of meat-packing houses, dairies and other industries that require cold storage are also saving space and money with Cold Diffusers.

This improved system, entirely different from other forms of applied refrigeration, gives positive air circulation and uniform cold in every part of the storage room. It was designed and perfected by engineers who have had a quarter century experience in applied refrigeration, heat transfer, ventilating and air distribution.

We suggest that you let one of our engineers explain to you—without obligation on your part—just how a complete Cold Diffusing System, consisting of Cold Diffusers and Brunswick-Kroeschell refrigeration machinery, can save space and money in your plant. Or how Cold Diffusers alone may be incorporated in your present system.



THIS CARRIER B-K COLD DIFFUSER *gives the New York plant of Preserves & Honey, Inc., an extra row of barrels in its storage room. Brunswick-Kroeschell refrigeration completes this Cold Diffusing system.*

★

Other Carrier Corporation services available to food industries

REFRIGERATION MACHINERY. Brunswick-Kroeschell systems are built for practically any kind of refrigerant and any capacity. They are backed by the trustworthy experience of more than 30 years' refrigeration engineering on land and sea.

• • •

DRYING EQUIPMENT. The Carrier Ejector Dryer for controlled limit drying with humidity control and the Carrier Gordon Dryer for fast drying are leaders in this field. Both show substantial savings in steam and power consumption, shorter drying cycle and definite schedule with no production hold-ups before or after the drying process.

• • •

MANUFACTURED WEATHER. The Carrier system of air-conditioning maintains exact temperature, humidity and air purity necessary to many food processes. It is used by producers of cereals, sausages, candy, flour, sugar and other weather-sensitive foods.

• • •

UNIT HEATERS. Carrier-York Heat-Diffusing Units save as much as 25% in fuel costs by holding more heat in the working zone of your factory through Controlled Zone Heating and the exclusive fuel-saving feature of Super-Control Regulation.

Carrier Corporation

CARRIER ENGINEERING DIVISION, Air Conditioning Equipment
850 Frelinghuysen Ave., Newark, N. J.

CARRIER-YORK DIVISION, Unit Heating Equipment
1541 Sansom St., Philadelphia, Pa.

BRUNSWICK-KROESCHELL DIVISION, Refrigerating and Ice Making Machinery, New Brunswick, N. J.

Offices in principal cities all over the world

And Now » » » » »

perhaps we can all face the facts that—

THE frozen food industry can grow only as fast as the public accepts frozen foods.

The public cannot widely accept frozen food unless it is offered through many outlets. . . . The retail sale of *any* commodity depends largely on the number of available outlets. This is obvious!

To date, the average food store has not been an outlet for frozen foods because it has not been equipped to handle them. . . . such stores have refrained from putting in frozen food handling equipment because such equipment has cost too much money.

A real problem! Efficient low cost store equipment capable of holding foods at steady low temperatures must be available before frozen foods can be widely distributed.

DRYICE CORPORATION OF AMERICA has developed such store equipment. This equipment, long since developed, is today an economic possibility due to the special rates offered on "DRY-ICE*" for this use. Increased volume in National distribution, now makes these rates possible. *Clip and mail the attached coupon for full particulars.*

DRYICE CORPORATION OF AMERICA

52 Vanderbilt Avenue * * * New York City

These Branches in 24 Cities Provide Nationwide Service

ALBANY	CLEVELAND	LOS ANGELES	PEORIA
ATLANTA	DENVER	MASPETH, L. I.	PHILADELPHIA
BALTIMORE	DETROIT	MEMPHIS	PITTSBURGH
BOSTON	ELIZABETH	MINNEAPOLIS	ST. LOUIS
CHICAGO	JACKSONVILLE	NEW HAVEN	SAN FRANCISCO
CINCINNATI	KANSAS CITY	NIAGARA FALLS	SEATTLE

*"DRY-ICE" is our registered trade-mark for solidified carbon dioxide made or licensed by us, and for equipment made by DryIce Equipment Corporation or licensees for use with such solidified carbon dioxide. Above inventions patented or patents pending.

DRYICE CORPORATION OF AMERICA
52 Vanderbilt Ave., New York, N. Y.

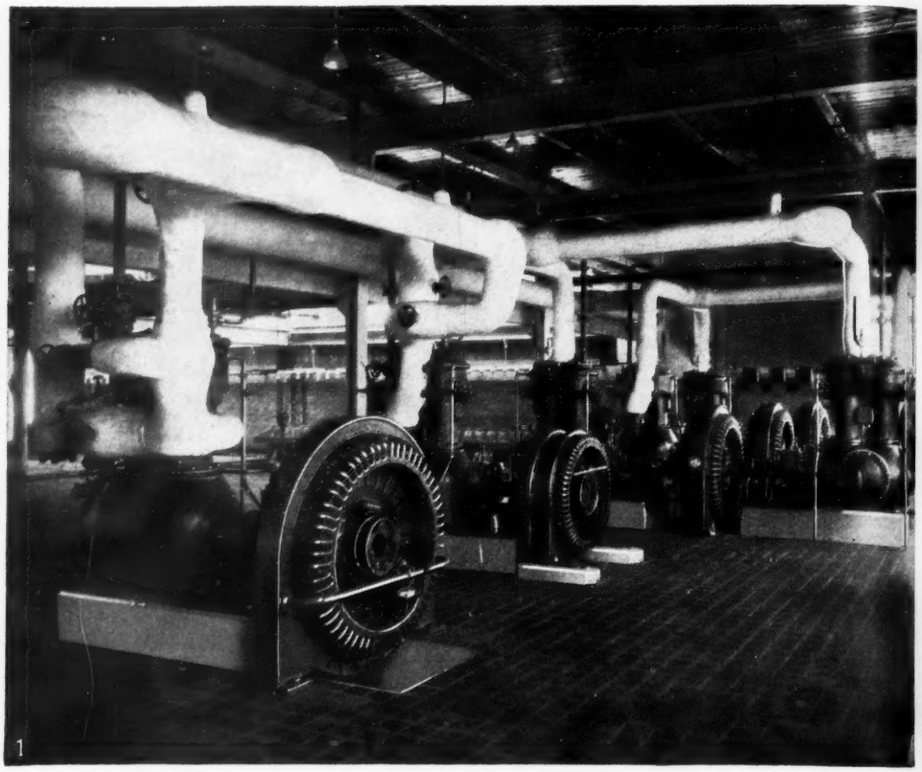
Kindly send full particulars regarding your new Low Cost Container for quick frozen foods.

Name.....

Company.....

Address.....

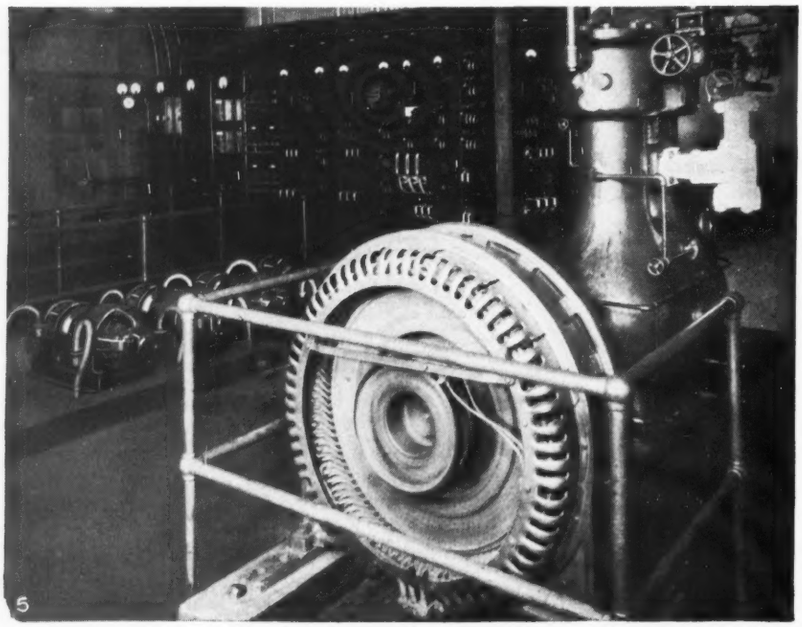
The Right Motor and the



THERE are few radical differences nowadays among motors or controllers made by reputable and experienced manufacturers.

Why then do so many manufacturers of refrigerating machinery prefer G-E equipment? Why do so many users of refrigeration specify "G-E motors and control" for the new equipment they order?

It is because General Electric can supply *both* the right motor and the right control for every refrigeration machine; because General Electric field representatives are so well grounded in applying the correct motor and controller to each type of machine; because General Electric stands squarely back of its customers with conveniently located stocks and service shops; because General Electric maintains, primarily on a *service* basis, a complete renewal-part service that is a model of efficiency and convenience.

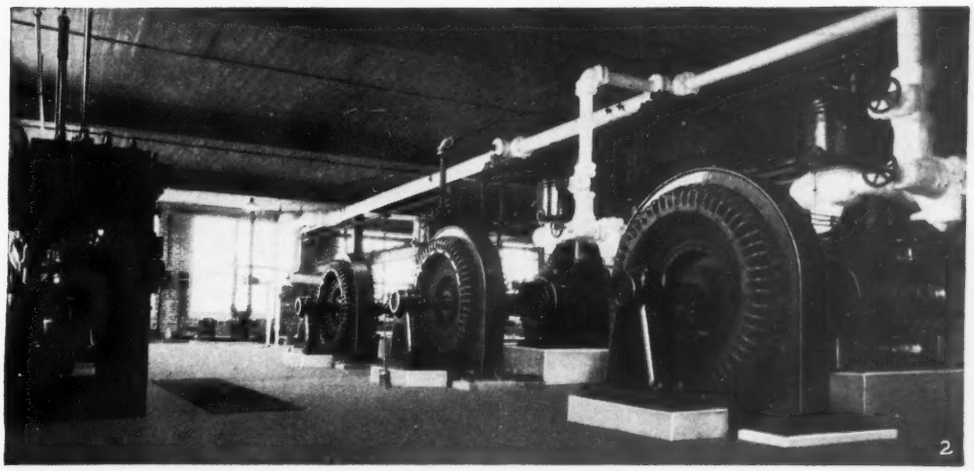


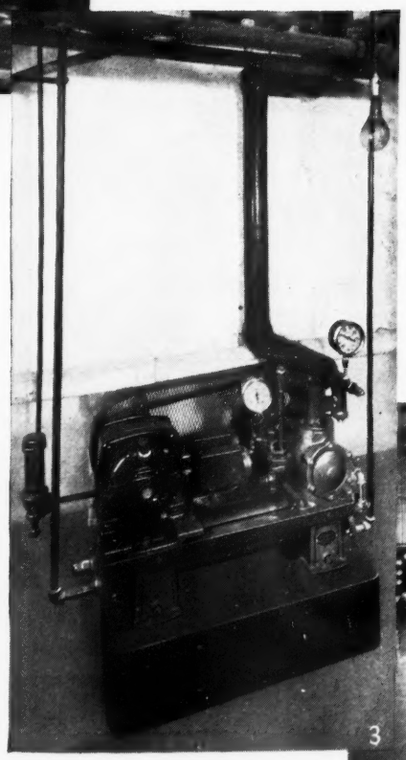
These tangibles, and many intangibles, are responsible for the following typical expression of confidence from a leading food producer:

"Our confidence in General Electric service and our experience with General Electric equipment is such that it is our present practice to specify General Electric equipment on all new machines which we order."

[JOIN US IN THE GENERAL ELECTRIC PROGRAM, BROADCAST EVERY SATURDAY EVENING ON A NATION-WIDE N. B. C. NETWORK]

Right Control *for Every Requirement of Refrigeration*





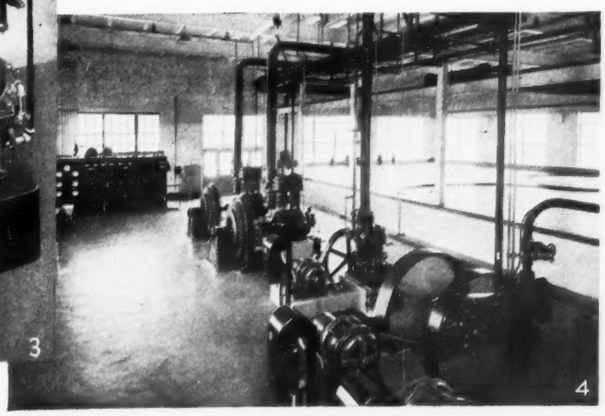
1. Seven G-E synchronous motors and the correct G-E control (not shown in this view) operating York compressors in this model plant of the Boston Ice Company

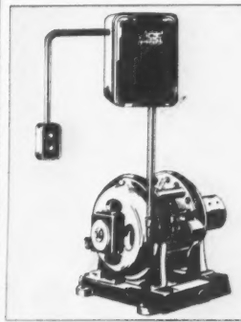
2. G-E synchronous motors and G-E control operating Frick ammonia compressors in the Winchester, Va., plant of C. L. Robinson Ice & Cold Storage Corporation

3. G-E Type SCR single-phase motor driving York ammonia compressor in a Philadelphia delicatessen shop

4. In this beautiful plant of the City Ice Company, Kansas City, Mo., G-E engineers were given *carte blanche* to supply the right motor and the right control for every drive in the plant

5. G-E synchronous motor driving York ammonia compressor in the plant of Atlantic Coast Fisheries Corporation. Note G-E exciter sets and G-E control.



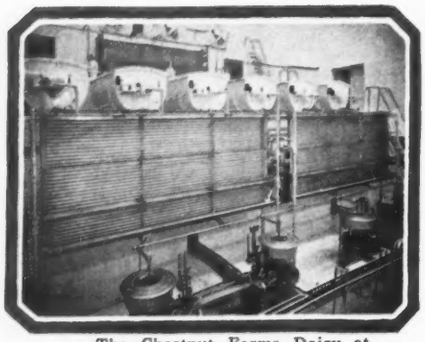


THE RIGHT MOTOR
THE RIGHT CONTROL
FOR EVERY APPLICATION

200-482

GENERAL ELECTRIC

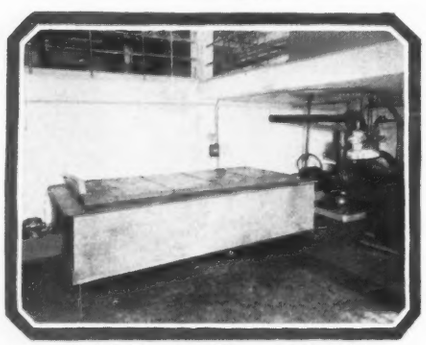
One of Ten Rooms Cooled by Frick Refrigeration at Meat Packing Plant of John Morrell & Co., Philadelphia



The Chestnut Farms Dairy at Washington, D.C., has a Frick Plant

Fruit Storages the Country Over Employ Frick Refrigeration

Scores of Bottlers Prefer Frick Cooling Equipment



Quick Freezing Plants Find Frick Refrigeration Both Reliable and Economical

FRICK

Refrigeration

While fruits and vegetables, and even meats and fish, depend upon sunshine for growth, they are equally dependent upon Refrigeration for adequate protection until packed, shipped, and sold.

All branches of the Food Industries—meat packers, fish dealers, fruit and produce shippers, creameries and ice cream plants, cold storages, bottlers, candy makers, markets, restaurants and scores of others—have come to depend on Frick Refrigeration as the Standard of reliability and satisfaction.

Thousands of eminently satisfactory installations in the Food Industries offer conclusive proof of the value of a Frick refrigerating plant. Over a dozen firms with world wide reputations in this field have from 25 to 550 Frick machines, each. Let us quote on your cooling requirements now.

Frick Company

WAYNESBORO, PA., U.S.A.

ICE MACHINERY SUPERIOR SINCE 1882

Branch Offices, Distributors and Stock Points in 85 Principal Cities throughout the World

CONVENIENT... LOW-COST STERILIZATION

FOR EVERY PART OF THE FOOD PLANT

Efficient, easy-to-use . . . and above all economical . . . H T H meets food plant requirements for an all-purpose sterilizer, disinfectant and deodorizer. ● In dairies, creameries, bottling plants, canneries, meat and seafood plants . . . wherever high standards of sanitation must be maintained . . . wherever products must be protected from spoilage . . . the stable, concentrated strength of H T H helps to safeguard profits. ● The use of H T H hypochlorite solutions simplifies plant sanitation problems. Modern food plants regularly use H T H solutions for rinsing utensils and equipment, for scrubbing or spraying tables, floors, walls, ceilings, for scores of important sterilizing and deodorizing operations in and around the plant. ● Guard against losses in your plant by using H T H. Put it to a practical test. Order a trial supply from your regular distributor. Write for booklets "Food Plant Sanitation" and "Chemical Sterilization."

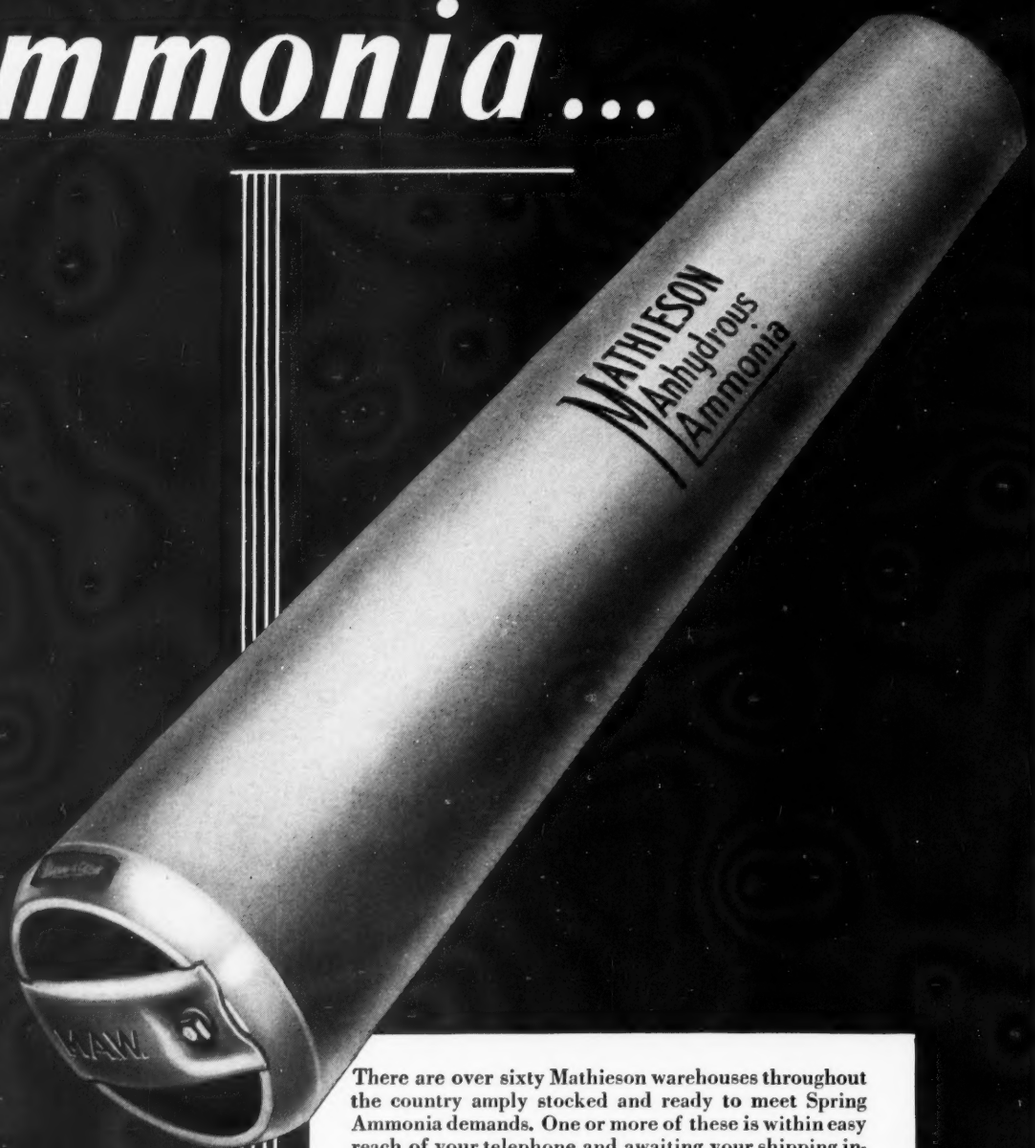
THE MATHIESON ALKALI WORKS (Inc.), 250 Park Avenue, New York, N. Y.

HTH
A Superior Product for Convenient and Accurate Preparation of Bleaching and Sterilizing Solutions
Stable — Readily Soluble — Uniform Concentrated
The HTH in this package contains 2½ lbs. Available Chlorine
Manufactured by
The Mathieson Alkali Works (Inc.)
250 Park Avenue, New York City

CHLORINE IN ITS NEWEST FORM

Readily soluble in cold water, H T H requires no special equipment. One can of H T H produces 30 gals. of stock hypochlorite solution containing 1% of available chlorine (10,000 p. p. m.) at a cost of less than 5¢ per gal. This stock solution is easily diluted with water to any desired sterilizing strength, or solutions can be made up in smaller quantities, as needed, from dry H T H. Stock solutions may be stored for prolonged periods of time without appreciable loss in strength.

MATHIESON
Ammonia...



There are over sixty Mathieson warehouses throughout the country amply stocked and ready to meet Spring Ammonia demands. One or more of these is within easy reach of your telephone and awaiting your shipping instructions... Experience has demonstrated to the refrigerating engineer that the Mathieson name is a guarantee of ammonia quality and a pledge of prompt and courteous service. That's the reason ammonia purchasers, year after year, specify Mathieson Aqua and Anhydrous Ammonia.

If you haven't a Mathieson "Ammonia Reminder Card", showing all warehouses serving your State, let us send one.

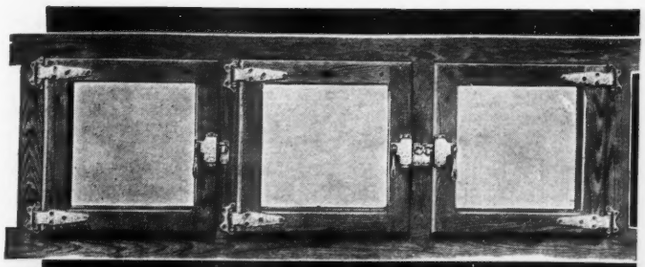
THE MATHIESON ALKALI WORKS (Inc.)
250 Park Avenue — New York, N. Y.

Soda Ash... Caustic Soda... Bicarbonate of Soda... H T H (Hypochlorite)... Liquid Chlorine... Bleaching Powder... Ammonia, Anhydrous and Aqua... PURITE (Fused Soda Ash)... Solid Carbon Dioxide

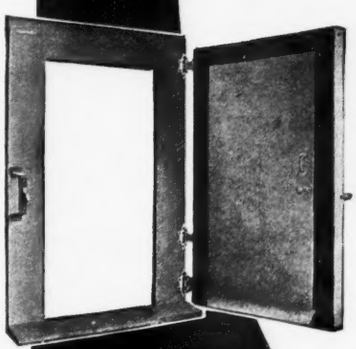
MATHIESON ALKALI WORKS INC. EAGLE · THISTLE CHEMICALS

SERVICE

RESOURCES | RESEARCH



COMPLETE PROTECTION FOR ALL WALL OPENINGS



AT TOP: Cold Storage Window

ABOVE: Vestibule Door (Stevenson "Door That Cannot Stand Open")

LEFT: Jamison Standard Cold Storage Door

BELOW: Super-Freezer Door (overlap type) frame without jambs

Jamison and Stevenson Insulated Products include:

DOORS: Standard Cold Storage Doors for all operating conditions, Vestibule Doors, Track Doors, Super-Freezer Doors; Double, Vertical Sliding, Dutch Track, WICKET and Auto-close (Double Swing Batten) Doors.

REFRIGERATOR FRONTS: Fully protective, of any shape or size built with wood or metal to match surroundings.

WINDOWS: Cold Storage, wherever natural light is required or display of products desired.

Can Passing Vestibules

Automatic Ice Chutes, three distinct types in single or multiple units.

All of these products represent years of experience in the cold storage field.

Write for catalog describing their advantages.

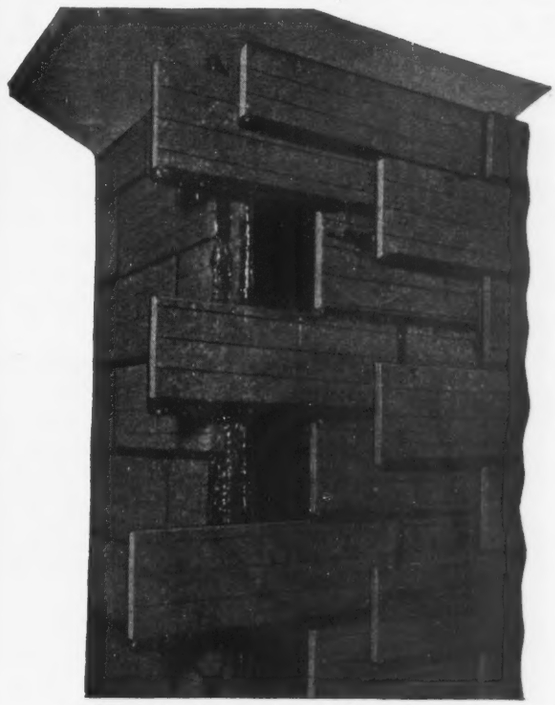
JAMISON COLD STORAGE DOOR COMPANY
CONSOLIDATING JAMISON COLD STORAGE DOOR CO., INC.
AND STEVENSON COLD STORAGE DOOR CO.
HAGERSTOWN, MARYLAND, U. S. A.

BRANCHES, Chicago, New York, St. Louis, Chester, Pa.; San Francisco, Dallas. Southern Ice Supply Co., Marietta, Ga. Gay Engineering Co., Los Angeles. D. E. Fryer & Co., Seattle and Spokane. Foreign: London, Honolulu, Japan.

Jamison & Stevenson Cold Storage Doors

OLDEST and LARGEST makers of Cold Storage DOORS

UNITED'S CORKBOARD



Column Insulation showing Corkboard joints broken in readiness to inter-lock with new solid Cork Wall.

EVERY piece of Corkboard is triple-inspected before it leaves our factory. Each drum of asphalt is produced under our own specifications to exacting standards. All mechanics employed in erecting the Corkboard are thoroughly trained for insulation work. Every contract is personally supervised by an experienced engineer. Consequently, satisfaction and economy are assured. More than 50,000 jobs testify to the expert workmanship and high quality materials which distinguish each UNITED'S installation.

Write to us

UNITED CORK COMPANIES
Lyndhurst, N. J.

UNITED'S SERVICE

Please attach business card or letterhead
UNITED CORK COMPANIES,
Grant Ave., Lyndhurst, N. J.

CLIP

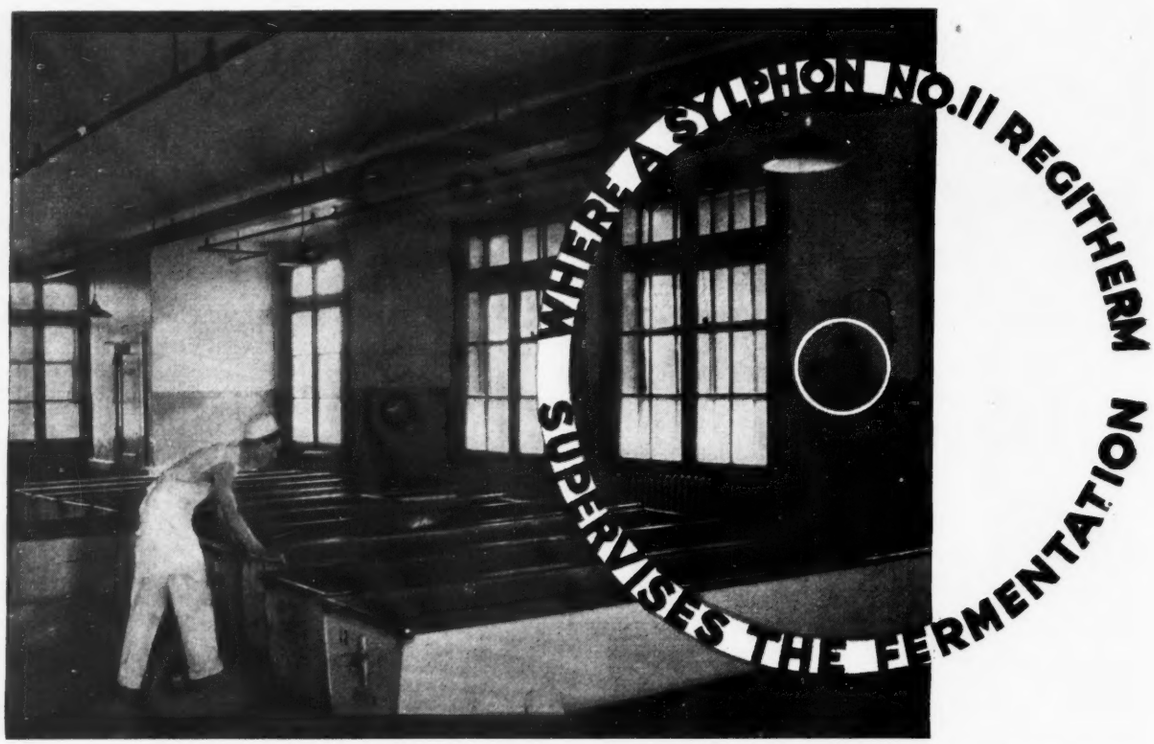
Without obligation please send your "Handbook on Insulation." We are contemplating installing new insulation on or about—

MAIL

Date .....
Name .....
Firm .....
Address .....
Send Your Representative Check ☐

250,000 LOAVES OF BREAD DAILY FROM THIS JACKSONVILLE PLANT

Your customers are your customers just so long as your products retain that high standard of quality. Today's production must be as good or better than yesterday's—otherwise your competitor gets the business. The Seybold Baking Company, Jacksonville, Fla., finds it much easier to produce quality products since Sylphon Automatic Temperature Regulators were installed. A Sylphon No. 11 Regitherm automatically keeps the temperature of their Fermentation Room at the proper point for bacteria development—one reason why their products are always in demand.



THE MOST PRACTICAL ROOM TEMPERATURE CONTROL

The Sylphon Regitherm is well suited for controlling temperature of the Fermentation Room or other rooms in the bakery; chocolate enrobing rooms in the candy factory; refrigerating rooms, etc., in fact, in any plant where dependable room temperature regulation is essential. This regulator requires no auxiliary source of power for its operation. It is complete in itself. Easily installed and gives perfect regulation for many years.

Get complete information on the Sylphon No. 11 Regitherm by asking for a copy of bulletin JG-175.

Sylphon

No. 1

Liquid Transmission

REGITHERM

The Sylphon No. 11-Z Regitherm is used for controlling refrigerating temperatures. It differs from our No. 11 only in temperature range. Hundreds are in use and users speak highly of their performance.

Our interesting bulletin No. JG-150 sent on request and without obligation.

FULTON SYLPHON CO.
KNOXVILLE, TENN., U.S.A.

European Representatives, Crosby Valve and Eng. Co., Ltd., 41-2 Foley St., London, W. I., Eng.; Canadian Representatives, Darling Bros., Ltd., 140 Prince St., Montreal, Que., Can.

REPRESENTATIVES IN ALL PRINCIPAL CITIES IN U. S. A.

Ideal For Quick Frozen Foods

LONG AGO, Sealright Leak-Proof Containers became the nation's choice for fresh packed moist and juicy foods. Now they have demonstrated their dependability and economy for quick-frozen fruits, vegetables and other cold-packed products.

Made of pure spruce-pulp paper, thoroughly impregnated with paraffine, Sealrights are leak-proof, crush-proof, practically air-tight. They have a patented double bottom for double safety, and snug-fitting cover-all cover (not a disc).

By packing your frozen foods in Sealrights, you immediately cash in on the public preference for products packed in these round, rigid, rugged containers. Nine years of national advertising have taught consumers everywhere the advantages of buying foods in Sealrights.

Any food in a Sealright is as easy and safe to carry as a box of crackers. It pays to pack foods the way customers prefer.

You may obtain Sealright Containers plain or colorfully printed to make your package appeal to the eye just as your product appeals to the appetite. Sealrights are available in all standard liquid or dry-measure sizes up to 1 gallon or 10 pounds. Write today for samples and full information. Sealright Co., Inc., Dept. FO-1 Fulton, N.Y. Canadian Address: Canadian Sealright Co., Ltd., Peterborough, Ont.

SEALRIGHT
LEAK-PROOF
FOOD CONTAINERS

Since we met the Morehead *Engineer . .*

"We Are Draining All of Our Steam Heated Equipment by Your Method"

Information received from users all over the country shows conclusively that Morehead Back-to-Boiler Systems are saving money every day in every industry where steam is used in process work.

This letter from a user in North Carolina* is a case in point:

"Some ten years ago we began the use of your Back-to-Boiler System, which proved so satisfactory that we made a complete job of it. We are draining all of our dry kilns as well as heating and feeding boilers entirely by your method. The results are—better drying and production from the kilns, and increased boiler capacity as well as savings in fuel. We are very much pleased."

The Morehead Engineer will be glad to tell you, without obligation, how you can increase efficiency, reduce fuel and water consumption, and cut repair and replacement costs in your plant. Send for him.

Our helpful 44-page booklet is yours for the asking.

***Myrtle Desk Company**

MOREHEAD MANUFACTURING CO.
DEPARTMENT FI - - - DETROIT, MICHIGAN

Morehead **Back to Boiler SYSTEM**

FACT NO. 7
Eliminates need for a lifting pump, taking the place of such a pump and operating as simply as the law of gravity.

COUPON

Morehead Mfg. Co.,
Department FI,
Detroit, Michigan

I'd like to have your interesting 44-page booklet, giving helpful information regarding the Morehead Back-to-Boiler System. This will, of course, place me under no obligation.

Name_____

Company_____

Address_____

City_____ State_____

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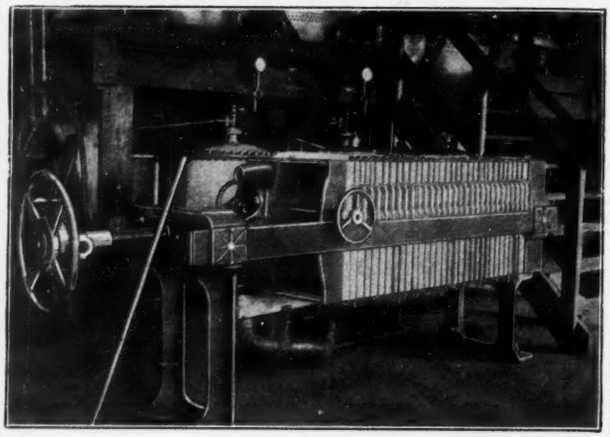


Shriver Filter Presses Filter Welch's Grape Juice

The clarity, sparkle and animated appearance so apparent in Welch's Grape Juice is occasioned in no little degree by filtration with Shriver Filter Presses. The Welch Grape Juice Company, Westfield, N. Y. use a number of Shriver Filter Presses for filtering and clarifying their noted product.

Your inquiries are solicited.

T. SHRIVER & COMPANY
Established 1860
860 Hamilton Street Harrison, N. J.

A Filter Press For Every Purpose

SHRIVER

Filter Presses Filter Cloth Diaphragm Pumps

Where cleanliness is vital

IN THE preparation of pure, wholesome food products absolute cleanliness of equipment is needed to avoid contamination and to assure quality.

Vats, kettles, filling machines, pipe lines and containers are made scrupulously clean with the least effort and at low cost the Oakite way. Dirt, grease, and slopped over food yield quickly and completely to Oakite's powerful cleaning action. A final rinse and no film or deposits of any kind remain on surfaces to collect dirt and afford a breeding place for bacteria.

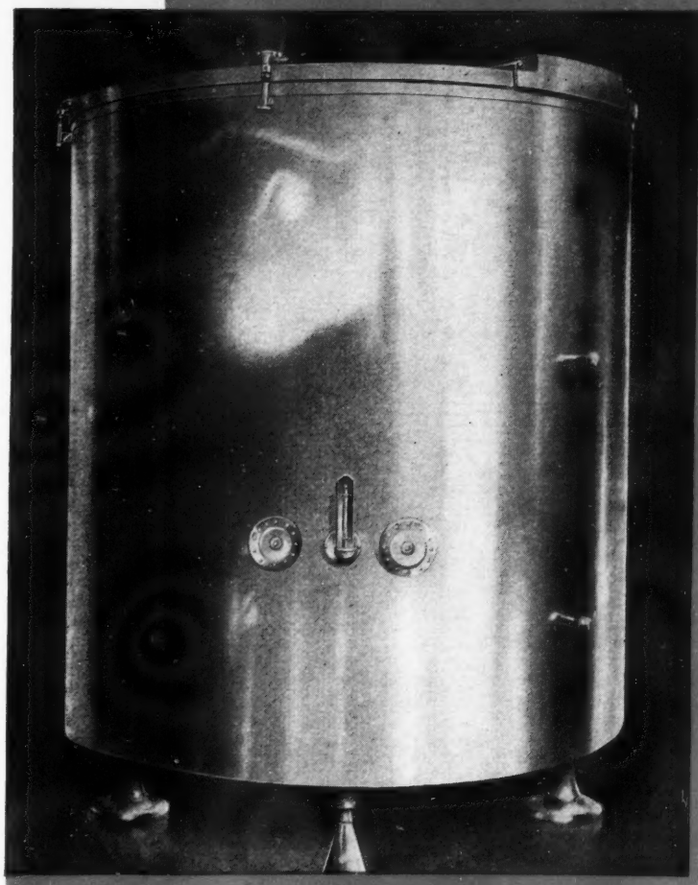
Our nearest Service Man can show you how Oakite materials assure thorough cleanliness at lowest cost. Write for him to call.

Oakite Service Men, cleaning specialists, are located in the leading industrial centers of the United States and Canada

Manufactured only by
OAKITE PRODUCTS, INC., 26G Thames St., NEW YORK, N. Y.

OAKITE
TRADE MARK REG. U. S. PAT. OFF.
Industrial Cleaning Materials and Methods

AS SANITARY AS GLASS and NON-SHATTERABLE!



1000 gallon stainless pasteurizer at the New York Eskimo Pie Corporation, mfd. by York Ice Machinery Corporation, York, Pa.

the life-time STAINLESS Pasteurizer

DAIRIES now using ENDURO equipment say that obsolescence is apparently the only factor which will determine the useful life of equipment fabricated from this improved stainless steel. ■ It has all the advantages of the best equipment formerly used plus the high strength and non-shattering qualities of steel. It even resists denting...or scratching...due to the exceptional strength of this improved material. ■ This means that with ordinary use, ENDURO equipment will give a life-time of service, since ENDURO cannot corrode or discolor, and will never taint milk products. ■ No wonder then that progressive manufacturers of dairy equipment are now fabricating from ENDURO and passing along to their customers the advantages and operating economies of this safe, life-time metal. Be sure you specify it by the name ENDURO when ordering equipment.

ENDURO
REPUBLIC'S PERFECTED STAINLESS STEEL

ENDURO

Enduro KA2 is sold only through Republic Sales Offices and authorized Distributors.

CENTRAL ALLOY DIVISION
REPUBLIC STEEL CORPORATION
Massillon, Ohio

GETTING THE "BIG IDEA"

TINY bubbles rising from a tea-kettle—that was all. It had been a common sight to generations of men.

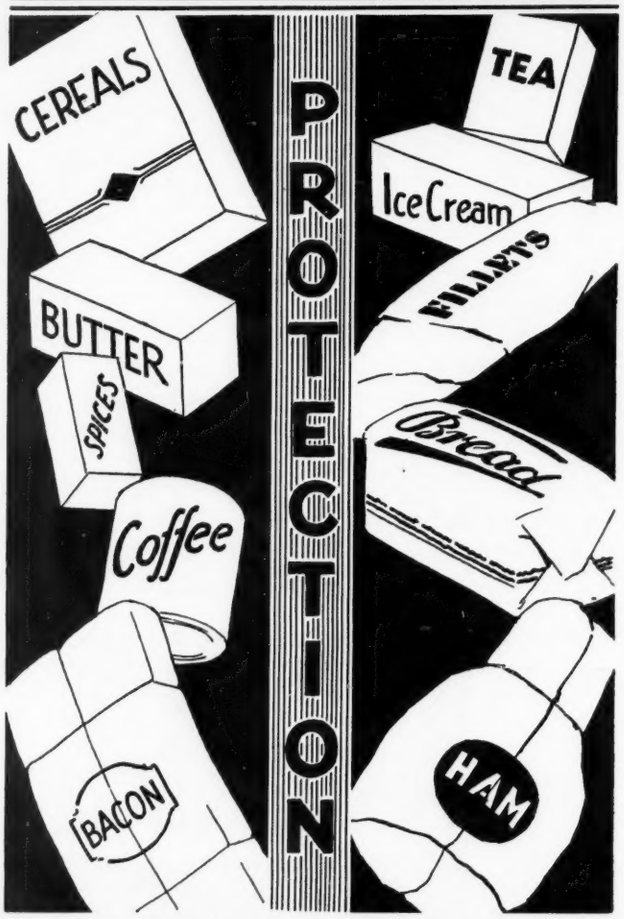
But the vision James Watt saw, in the tiny clouds of steam, the power which should re-make the world — he had the "big idea."

Just so the business of this Company has been built around **Ideas!** Not simply making Paper but developing all its possibilities for the service of the people. On this service has been established the growth and continued success of "The World's Model Paper Mill."

This service is more than a question of the right wrapping; it means full protection for all kinds of food products, under all conditions. Every member of this Company — from the president to the humblest in overalls, is on the alert to find better ways to fulfil present needs and anticipate the new.

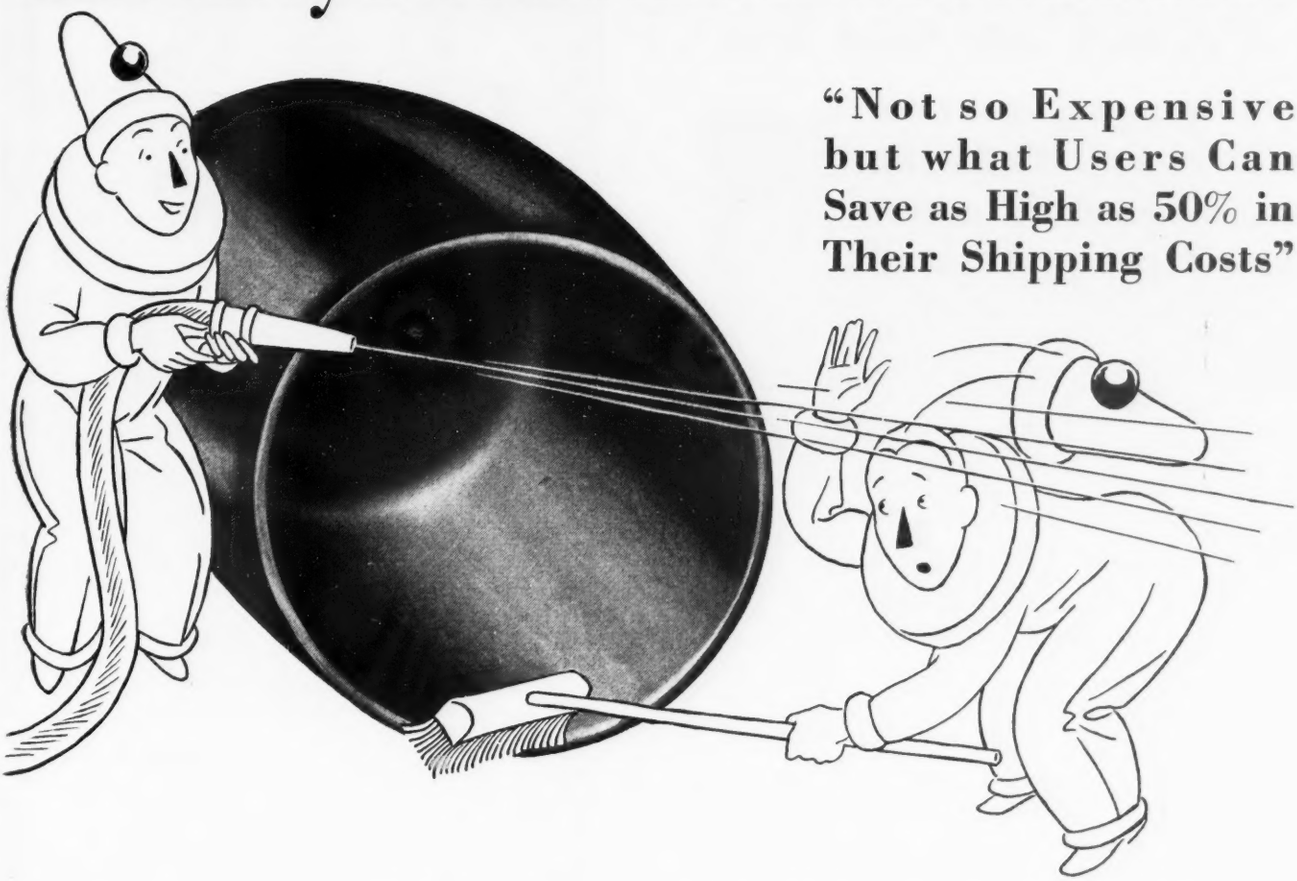
KVP Laboratory research experts are at your command; if need arises for some special, exclusive type of protection, do not hesitate to call on us for advice and suggestion.

KALAMAZOO
VEGETABLE PARCHMENT CO.
KALAMAZOO -- MICHIGAN



KVP PROTECTION PAPERS • • •

How Expensive is it to Clean Hackney Permanent Containers?



"Not so Expensive but what Users Can Save as High as 50% in Their Shipping Costs"

Naturally, the cost of cleaning Hackney permanent containers varies with the kind of products shipped.

But the saving in shipping costs over light weight packages is usually great enough to far more than offset this additional expense.

For example, manufacturer "X," shipping a product difficult to clean from the inside of a container, estimated that Hackney returnable steel barrels saved him $13,500 last year.

This saving undoubtedly would have been smaller, except for the fact that Hackney Seamless Steel Barrels have no cracks, crevices or inward projections to catch and hold the material.

This is one example of what many manufacturers are saving after taking into consideration such costs as depreciation, interest, return freight, insurance, clerical work, and extra freight on out-shipments, as well as cleaning.

Hackney permanent containers may also reduce your shipping costs. Let us assist you in making an investigation, which will determine this point.

A Few Prominent Hackney Users

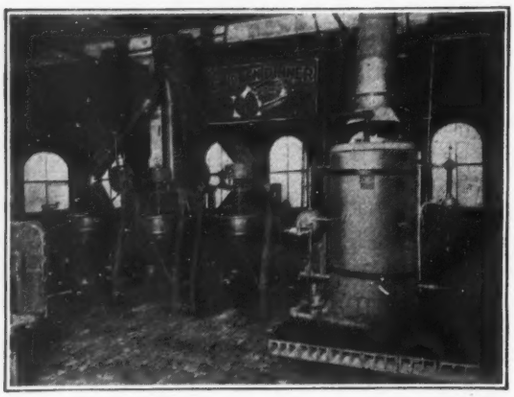
Frigidaire • Hercules Powder • Virginia Smelting • Wadhams Oil • Pittsburgh Plate Glass • Swift & Co. • Spencer Kellogg • Illinois Central • Vegetable Oil Products.

PRESSED STEEL TANK COMPANY

1173 Continental Bank Bldg. . . . . Chicago
1349 Vanderbilt Concourse Bldg. . . . . New York City
5771 Greenfield Avenue . . . . . Milwaukee, Wis.
477 Roosevelt Bldg. . . . . Los Angeles

Hackney
MILWAUKEE

"Summer Steam" .. for all food Processes can Cost you less ..



Steam in 4 minutes
Ofeldt
TRADE MARK

With this Gas Boiler!

If you run a coal-fired heating boiler the entire year just to get steam for certain food processes—you are losing money *in the summer* on labor, fuel, maintenance, and time. The actual amount of steam needed in most cases is too small to justify high-capacity heating boiler operation at low efficiency—

On the other hand, with an OFELDT automatic gas-boiler of the exact capacity needed (single or multiple units) you eliminate licensed labor, delays, firing, fuel and ash problems, long wasteful pipe lines, and *uncertainties.*

Steam from an OFELDT is *clean* (for live steam treatments) unfluctuating, abundant always. Further, the OFELDT steams 4 minutes after lighting. Since the initial investment is small, an OFELDT pays impressive returns on summer savings alone, to say nothing of all the obvious and incidental advantages of gas fuel and automatic operation.

We shall be glad to discuss Ofeldt economies with application to your steam problems.
Get in touch with us.

MEARS-KANE-OFELDT INC.

1903-1915 EAST HAGERT ST., PHILADELPHIA

New York—9 Park Place
Boston—100 Arlington St.
Chicago—325 West Huron St.
Buffalo—Waldridge Bldg.
St. Louis—2010 Locust Blvd.
Birmingham—Am. Trust Bldg.

AN ADHESIVE FOR EVERY MACHINE OR HAND OPERATION

Too Old To Learn?

Not by a long shot—if you have real American business-blood in your veins. Then let us demonstrate

MIKAH
BOTTLE LABEL GUM

right in your own plant and show you just what advantages you will get from a modern Bottle Gum.

No obligation, of course. Write today.

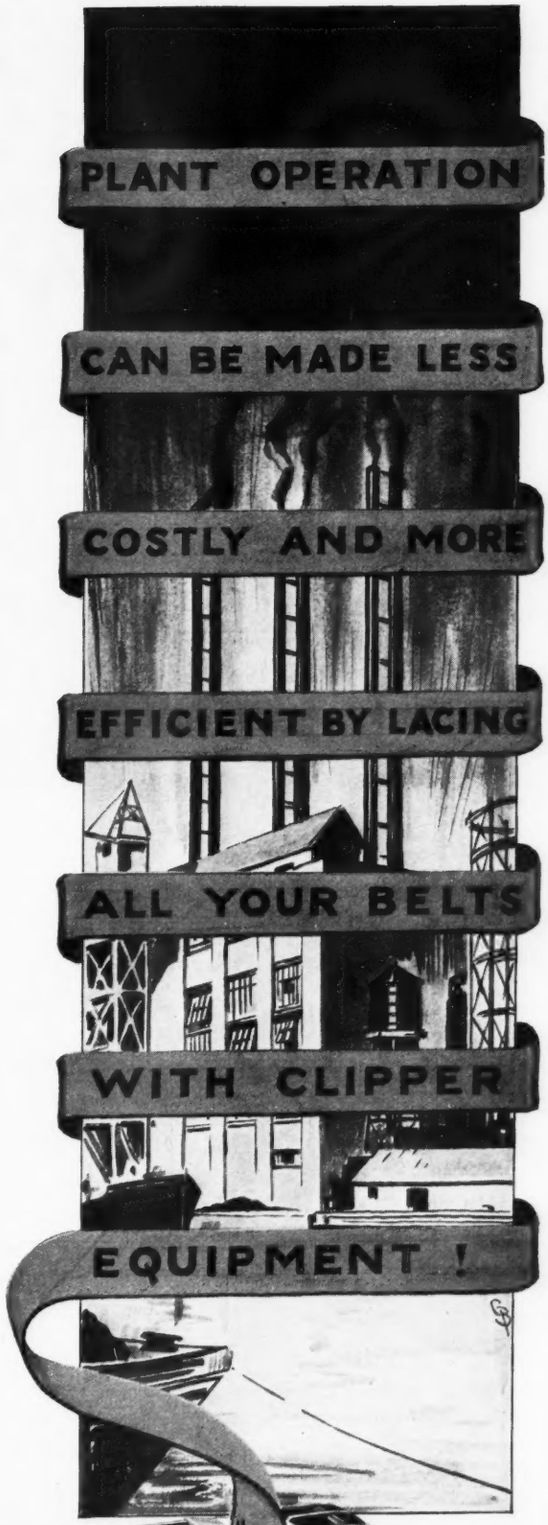
NATIONAL ADHESIVES CORPORATION

Home Office—820 Greenwich St., New York

1940 Carroll Ave., Chicago—883 Bryant St., San Francisco
15 Elkins St., Boston—1305 Germantown Ave., Philadelphia

WORLD'S LARGEST PRODUCER OF ADHESIVES

Sales Offices in all principal cities



QUALITY BELT LACING

Leading industrial plants throughout the world depend on Clipper lacing equipment to help maintain a maximum of continuous production.

Clipper Hooks are actually 20 to 30% lower in price than other makes, yet are unsurpassed in quality and durability.

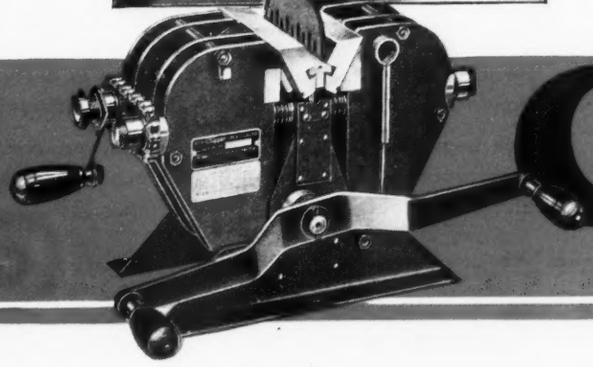
The Clipper No. 6 Speed Lacer, weighing only 56½ lbs., with a pressure of 37,500 lbs., is the last word in belt lacing speed and efficiency.

In exactly 90 seconds this remarkable machine will lace both ends of any belt up to six inches in width with uniform smoothness and precision.

Clipper Lacers are made in types to meet every shop requirement. With Clipper Hooks and Pins they ensure perfect, lasting joints.

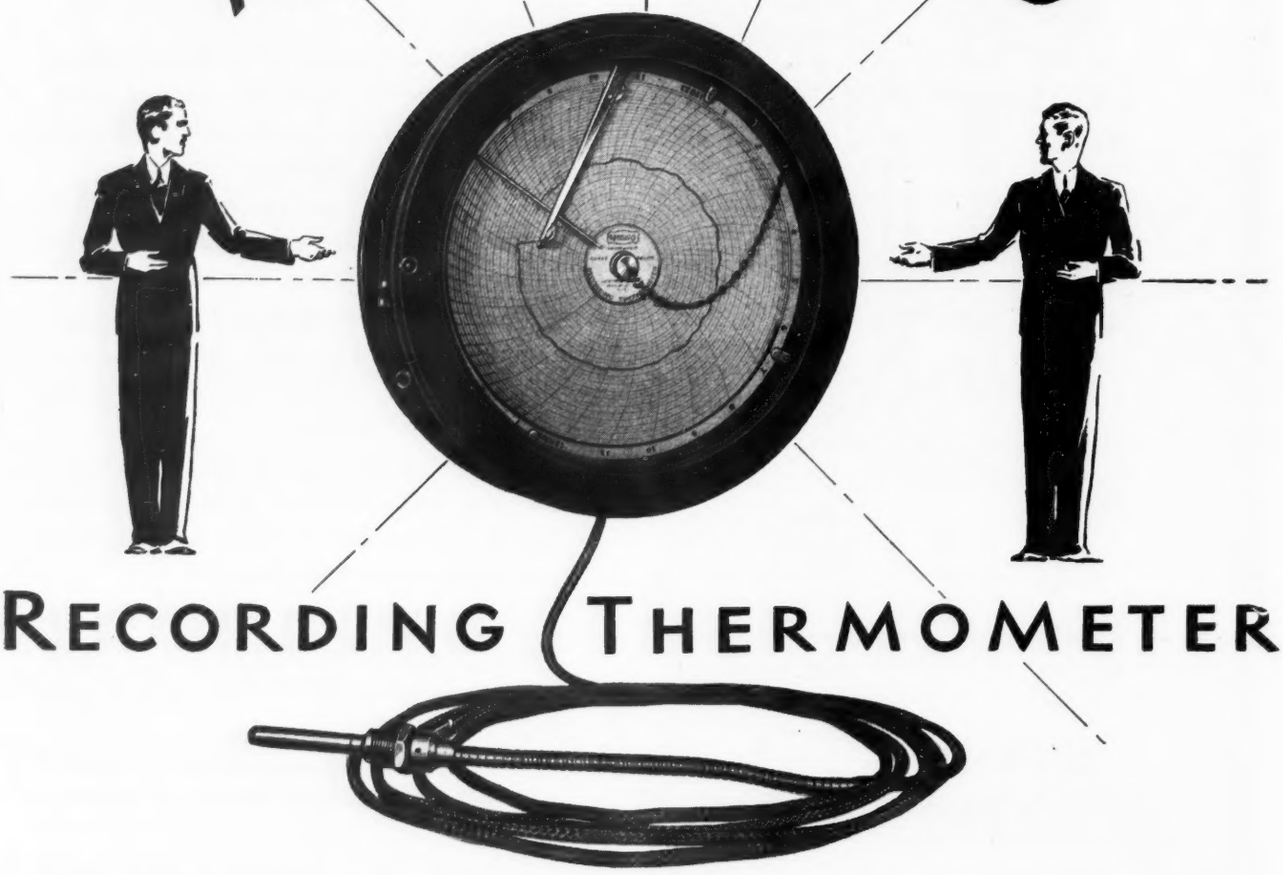
For complete demonstration, communicate with your nearest dealer or with the

Clipper Belt Lacer Company
GRAND RAPIDS MICHIGAN



Clipper

MOTOMETER PRESENTS MODEL 1000



RECORDING THERMOMETER

SIMPLICITY is the keynote of design in this new Moto Meter instrument. Years of research and experiment combined with the knowledge accumulated in twenty years of fine instrument building are embodied in the new Model 1000—MOTOCO Recording Thermometer.

The MOTOCO Recording Thermometer is offered in one model—Model 1000. For wall mounting, including 10 feet of capillary tubing. Standard scale ranges vary between the limits of minus 40 and plus 750 degrees Fahrenheit, or the equivalent in Centigrade.

The MOTOCO is fully compensated for pressure and temperature. Capillary tubing can be furnished up to and including 50 feet. This armor-protected capillary tubing is the most flexible available and may be bent repeatedly without breaking. Being made of non-ferrous metals, both tubing and armored protection are not affected by moisture.

The entire movement is enclosed in a dust, fume and moisture-proof case, made of molded composition. Electric clock movement can be furnished in place of the standard mechanical movement at slight additional cost.

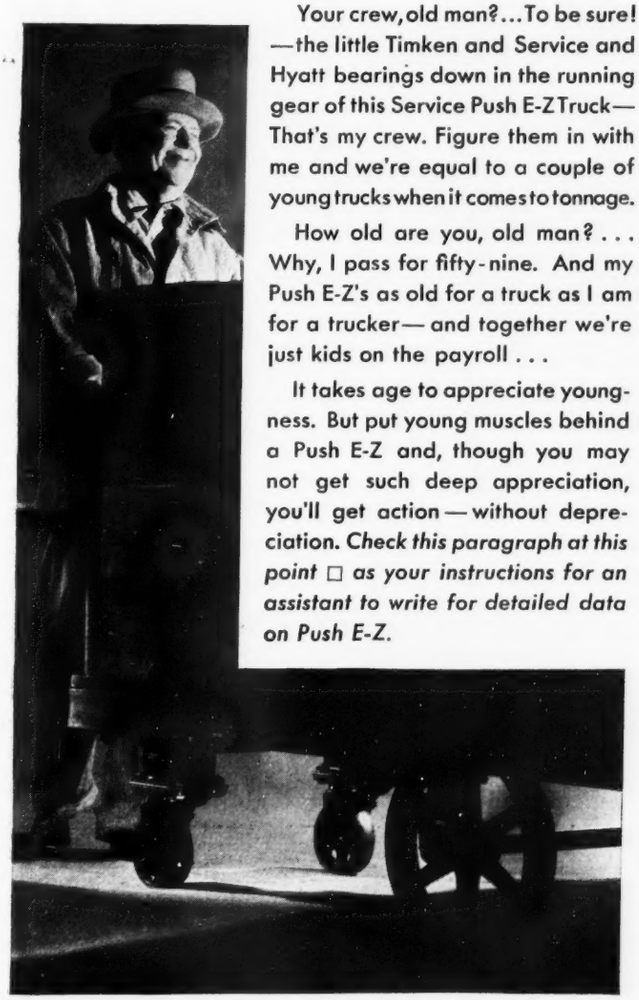
Our engineers will gladly consult with you concerning your problems on the control and recording of temperatures—there is no obligation involved.

MOTO METER

GAUGE & EQUIPMENT CORPORATION
TOLEDO, OHIO
FACTORIES AT TOLEDO • LA CROSSE • CANADA
ENGLAND • FRANCE • GERMANY • AUSTRALIA

Old Man, How Goes It?

Goes like a brand new baby carriage, thank you. But it's been many a year since I pushed a ten-pound live load. Me and my crew sort of specialize in dead weight, swinging tonnage along with the youngest of them.



Your crew, old man?...To be sure! —the little Timken and Service and Hyatt bearings down in the running gear of this Service Push E-Z Truck— That's my crew. Figure them in with me and we're equal to a couple of young trucks when it comes to tonnage.

How old are you, old man? . . . Why, I pass for fifty-nine. And my Push E-Z's as old for a truck as I am for a trucker— and together we're just kids on the payroll . . .

It takes age to appreciate youngness. But put young muscles behind a Push E-Z and, though you may not get such deep appreciation, you'll get action — without depreciation. *Check this paragraph at this point □ as your instructions for an assistant to write for detailed data on Push E-Z.*

SERVICE CASTER & TRUCK CO.
525 N. Albion St., Albion, Michigan

Chicago: 603 Washington Blvd. New York: 200 Lafayette St. Philadelphia: 401 N. Broad St.
San Francisco: 61 Bluxome St.
England: 15 Mallow St., Old St., London. Canada: Brock & Campbell Sts., Brantford, Ont.

Service
PUSH E-Z TRUCK

CITRIC ACID

Merck's Citric Acid is the Gold Medal Standard for food, confectionery and beverage products. We have had 58 years of experience in the manufacture of this article . . . Merck's Citric Acid is supplied in the crystal, granular and powder forms . . . Shipped in kegs, barrels or carloads . . . Also Lactic, Tartaric, Phosphoric and other acids . . .

Elliott Cresson Gold Medal awarded for perfection of product.

SODIUM BENZOATE

Merck's Sodium Benzoate is white, clearly soluble, and free from foreign odor or taste . . . Approved by the manufacturers of delicately flavored products . . . . . .

METHYL SALICYLATE

One of Merck's "taste-like-more" flavors for fine confectionery, extracts, birch beer and other food products . . . Imparts the true flavor of Wintergreen . . . Our facilities are unlimited. Stocks fresh and pure. Put up in convenient 50 lb. tins or larger . . .

CREAM OF TARTAR
MILK SUGAR
VANILLIN

and many other products

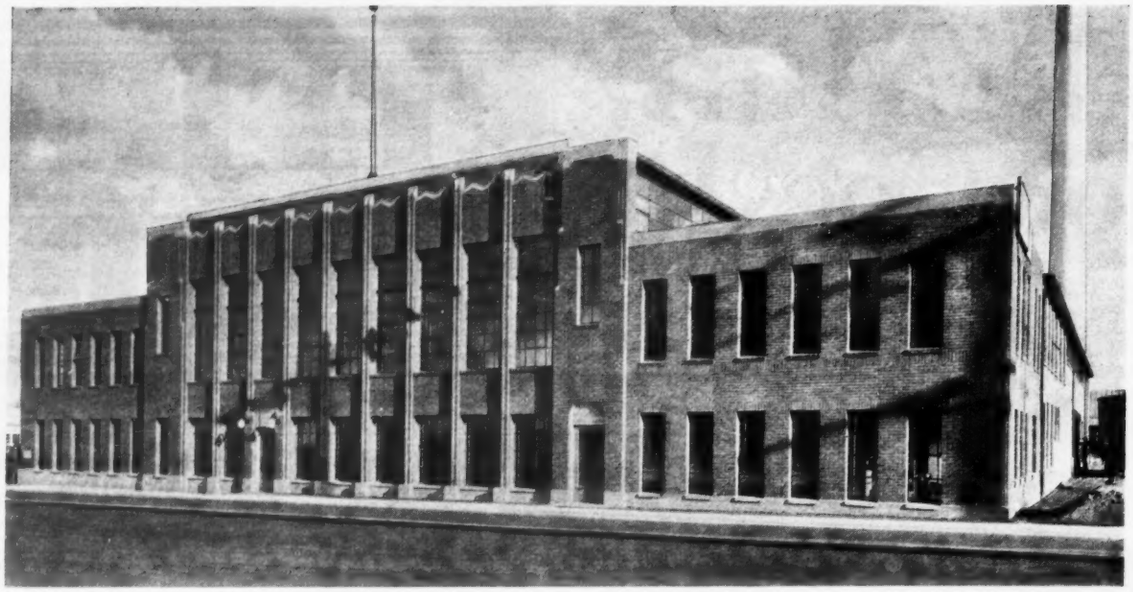
FOR DAIRY CONTROL

Our Ether Concentrated and Benzin Purified are especially designed for large-scale fat determinations in the control of dairy products . . . .

The services of our Sales Organization and the scientific resources of our laboratories are at your disposal in the selection of products adapted to your needs.

MERCK & CO.
INC.
MANUFACTURING CHEMISTS

Industrial Division: 916 Parrish St. Philadelphia — RAHWAY, N. J. — New York — St. Louis — In Canada: MERCK & CO. LTD. Montreal



Dairymen's Cooperative Creamery of Boise Valley, at Caldwell, Idaho. A modern, sanitary dairy plant of one-story and mezzanine type, designed and built by Austin. Equipment such as boilers, heating, lighting, plumbing, power wiring, etc., all handled under a single contract.

THE MODERN DAIRY . . .

a smooth-running machine

Plants that are forging ahead are those laid-out, designed, built and equipped to function like a smooth-running machine . . . geared with present-day economic needs . . . if the result is to be an efficient plant capable of more profitable operation.

The design of such a plant calls for engineering ability and experience of the highest order . . . for there are so many important factors . . . plant location, balancing of departments, flow of work, supervision, working conditions, piping for process water and steam, power and refrigeration, shipping.

Fresh, clean air, good light and ventilation . . . construction which embodies the advantages of permanence and sanitation in a plant designed to reduce labor costs . . . are all assured in plants designed, built and equipped by Austin.

Austin's plan of Undivided Responsibility provides for a complete service. Layout, designing, construction and equipment engineers develop your plant from start to finish . . . turning over to you at the completion of their contract, a complete plant ready for production.

For an interesting discussion of your problems why not phone, wire or mail the convenient memo below? An Austin Engineer will be glad to give you helpful information and estimates on any contemplated project . . . without obligation, of course.

THE AUSTIN COMPANY

Engineers and Builders - - - Cleveland

NEW YORK CHICAGO DETROIT NEWARK
PHILADELPHIA CINCINNATI PITTSBURGH
BOSTON ST. LOUIS SEATTLE PORTLAND

THE AUSTIN METHOD

THE AUSTIN COMPANY OF TEXAS: DALLAS
THE AUSTIN COMPANY OF CALIFORNIA, LTD.: LOS ANGELES OAKLAND AND SAN FRANCISCO
THE AUSTIN COMPANY, LIMITED, TORONTO

Memo to The Austin Company, Cleveland ☐ Send copy of booklet "101 Questions That Should be Answered Before You Build."

☐ Our Door is Open to New Ideas! We are interested in a ..... project of approximately ..... sq. ft.

Location ..... Individual ..... Firm ..... City ..... F.I. 5-31

Answering the question, "Why are 'Clevelands' so dependable?" . . .

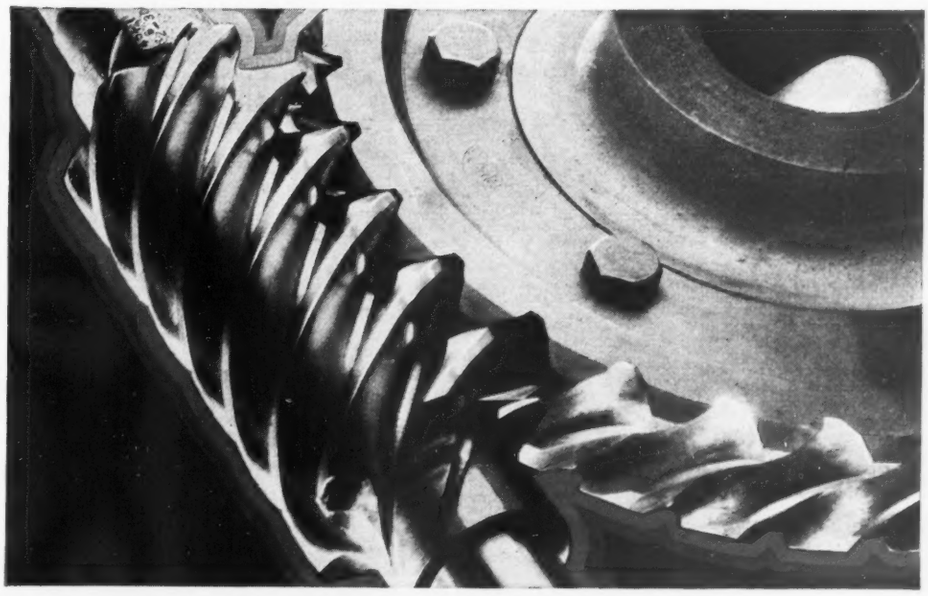
OWNERS of "Cleveland" Worm Gear units often ask the question, "Why are 'Clevelands' so dependable? Fundamentally, the reason is inherent in the worm gear principle of power transmission. The worm and worm gear is the simplest form of gearing—only two moving parts.

But more important still is the mechanical *action* of worm gearing under service conditions and the method in which wear takes place. In meshing with the gear teeth, the "Cleveland" worm follows precisely the same path as the hobs which cut the gear teeth. The worm therefore wears contours in the softer bronze gear without harming in the least the efficiency of the unit.

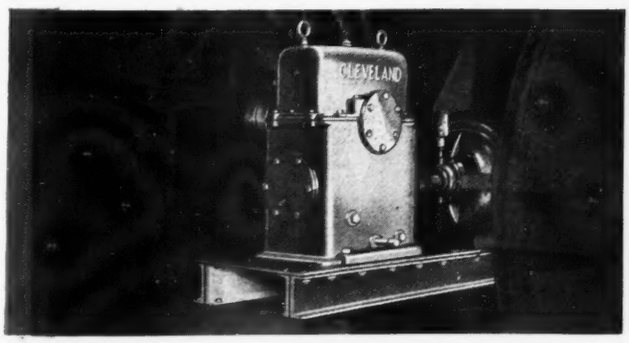
Other forms of gearing mesh in a direction perpendicular to the direction taken by the gear cutting tool. This wear on the teeth causes a distinct change in tooth contours—harmful to efficiency and strength.

To the advantageous principle of worm and gear, "Cleveland" has added the proper selection of metals to insure minimum wear over periods of years and the highest quality anti-friction bearings obtainable to maintain the gearing in close alignment.

That's why thousands of engineers who insist upon dependable power transmission and low maintenance costs, specify "Cleveland" Worm Gear Reduction Units.



"Cleveland" Unit Type 400AT driving a cooler. Ratio 15:1; 20 h.p. at 1150 r.p.m.

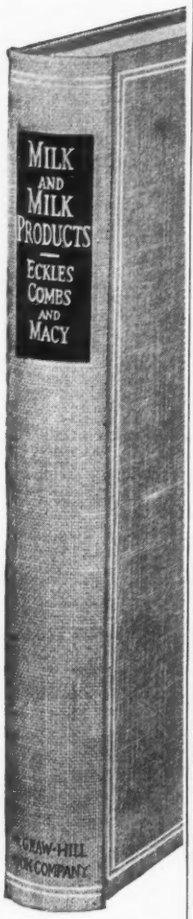


Write for these bulletins—Bulletin 108 gives data and specifications on units over five horsepower. For smaller units ask for Bulletin 110.

CLEVELAND
WORM & GEAR COMPANY
3251 EAST 80TH STREET . . . . . CLEVELAND, OHIO
CLEVELAND WORM GEARING . . . THE ULTIMATE DRIVE

Preparing milk and milk products for market—

This thoroughly modern work deals both with the scientific and practical methods of testing dairy products and preparing them for the market.



Milk and Milk Products

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Chief, Division of Dairy Husbandry, University of Minnesota

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Professor of Dairy Husbandry, University of Minnesota

and HAROLD MACY
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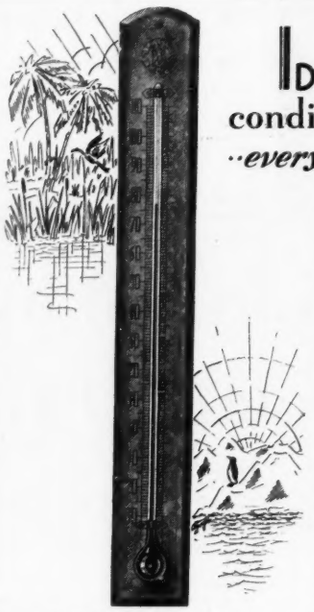

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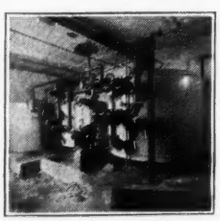
YOU PAY FOR SOFT WATER WHETHER YOU HAVE IT OR NOT



Raw water, or partly treated water, are expensive to use in power or process steam plants. The excess plant maintenance, the reduced efficiency and the uncertain results to be obtained build up an expense account that is an unfair burden to production costs.

Graver Water Treating Equipment will save its cost in only a short period of service. Its further use is *clear profit.* Ask our engineers to estimate the savings that Graver can make for *you.*

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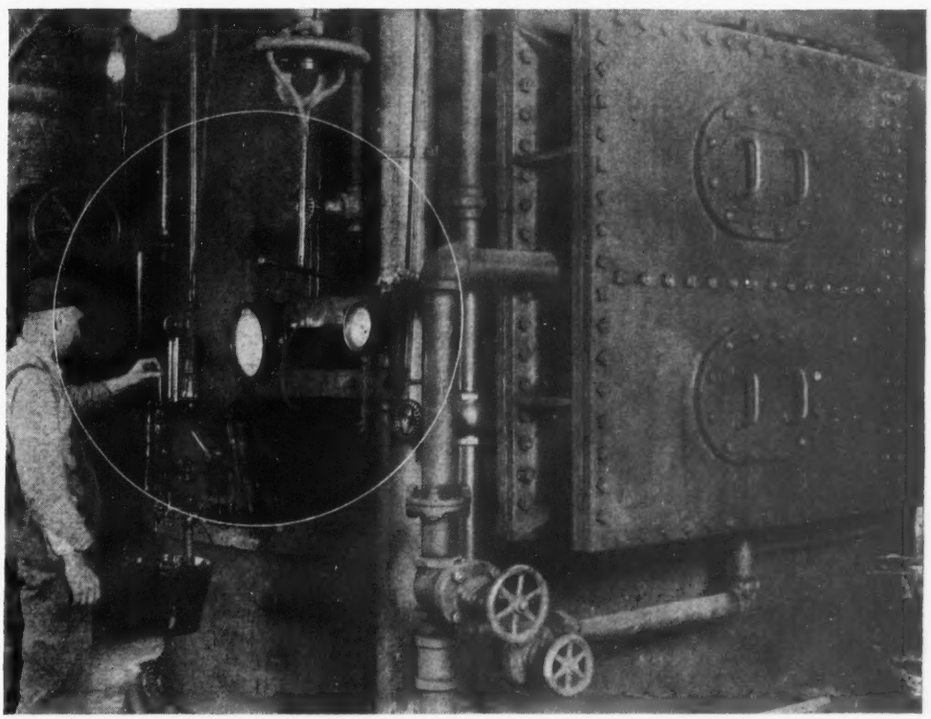


Foxboro Recording Thermometers on a finishing vacuum pan in the plant of the Clinton Corn Syrup Refining Company, Clinton, Iowa

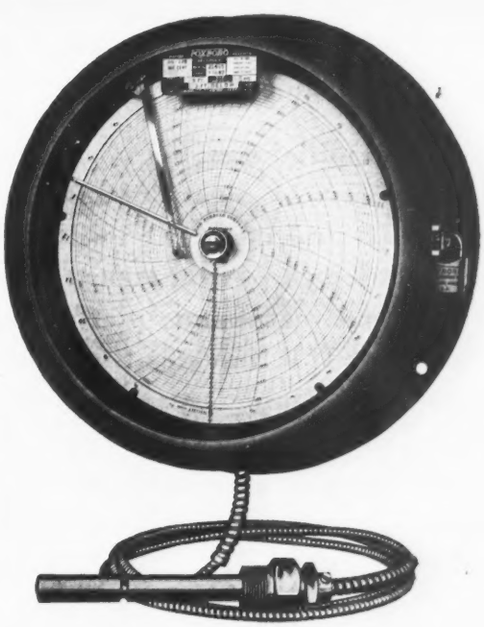
CHEMICAL reactions are as fixed as the stars and as certain as the laws of mathematics—"*if*" the determining factors are under control and can be accurately duplicated.

To be sure of this control, the Clinton Corn Syrup Refining Company have installed Foxboro Instruments to banish the "*if*" in their complicated food processing. When temperatures are known and kept exactly right, the rest is comparatively easy. A uniform product is obtained at a saving of time, labor and material.

Experience has demonstrated that, in comparison with such savings, the cost of Foxboro Recording and Controlling Instruments is negligible. Their accuracy and dependability meet every temperature requirement of food manufacturing and processing. They do the job efficiently at the lowest maintenance cost.

You will be interested in our new illustrated Recording Thermometer Bulletin just off the press. It is First Aid to the man for whom economy in power and production, and economy in instrument cost are important.

Just write for Bulletin B-169. It will be sent to you without any obligation on your part. A Post Card will do.



Foxboro Recording Thermometer

FOXBORO
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THE COMPASS OF INDUSTRY

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INSTRUMENTS *for* CONTROLLING, RECORDING *and* INDICATING TEMPERATURE, FLOW, HUMIDITY *and* PRESSURE

PHILADELPHIA CanHelp You

In solving the problems now confronting so many industries, many firms would do well to begin with a check-up of their present plant locations.

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Our engineers weigh every factor in relation to its effect on the *delivered-to-customer cost.*

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Send for booklet, "A Dollar-and-Cents Viewpoint on Plant Location," which tells in detail the important things you should consider in plant location. Please address Department O. on your business letterhead.

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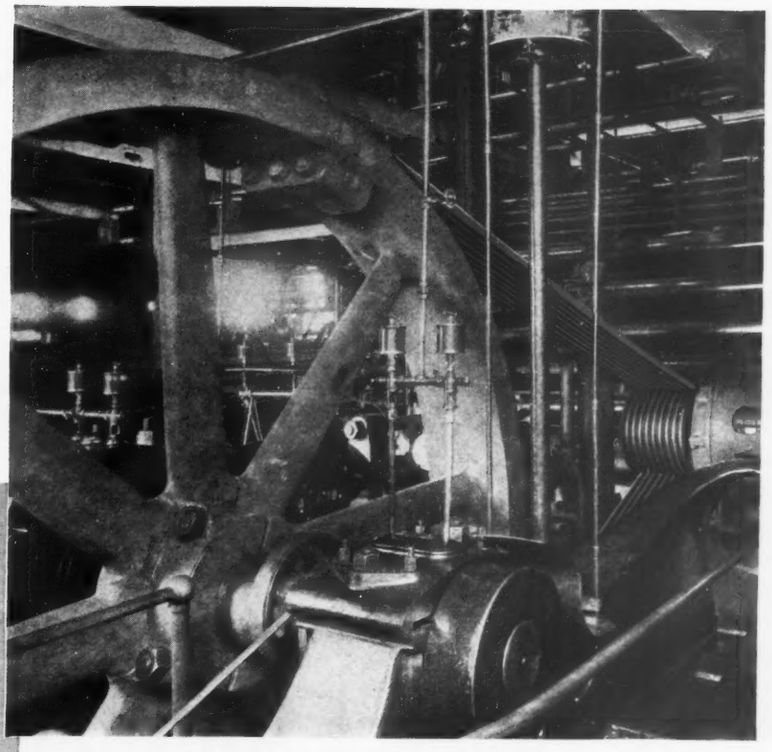
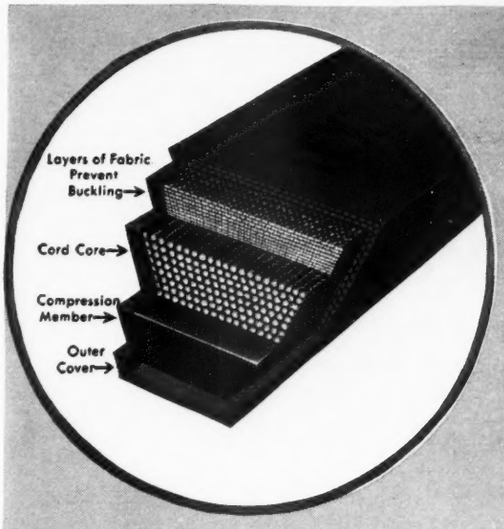
Texrope Drive Nearly Doubles Output of Ice Machine





— another B.F.Goodrich Product

An idea in 1923 . . . a product ready for market in 1925 . . . today an accepted necessity, with well over 100,000 units in use. That is the story of Texrope Drives . . . the most sensational success known to industry.

In the development of this drive the B. F. Goodrich Rubber Co. has contributed belts that possess amazing ability to stand up under constant flexing. Well over 600,000 Texrope Belts are now in use . . . and some of those put in service five years ago are still in operation. The newest design, here illustrated, promises to give even longer service. When new belts are finally needed, be sure to install genuine Texropes . . . product of B. F. Goodrich.

TEXROPE is the ideal drive for refrigerating machinery . . . dampness does not affect it . . . continuous operation eliminates danger of "white" ice . . . maintenance cost is extremely low.

How well Texrope Drives operate is evidenced by an installation at the Wayne Ice Company, Richmond, Indiana. A 125 h. p. Allis-Chalmers Texrope Drive and Motor took the place of a Corliss Engine, operating a 30-ton Wolf Ammonia Compressor.

Although planned as a standby unit, its performance has been so satisfactory that it has been in constant use, producing almost twice its rated capacity. The 122-inch sheave has 8,000 pounds of extra metal in its rim to produce the desired fly wheel effect. You can cut costs with Texrope Drives. May we send you a copy of Bulletin 1228?

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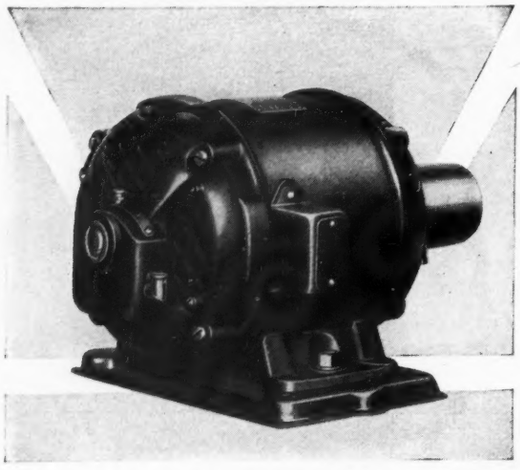
TEXROPE DRIVES

THE DRIVES THAT REVOLUTIONIZED TRANSMISSION PRACTICE • • •

THEY KEEP A-RUNNING



¼ Horse Power Direct Current Motor

Direct Current Motors

Century fractional horse power Type DM Direct Current Motors are built to meet the requirements of such exacting service as electrical refrigerators, oil burners, pumps, compressors and similar apparatus.

They withstand the dampness frequently surrounding such installations, and in humid tropical climates.

5 Horse Power Direct-Current Motor, with Enclosing Covers.

Bearings are made from phosphor bronze castings, the best bearing material obtainable. The Century wool-yarn system of lubrication assures at least one year's continuous 24-hour per day operation without reoiling.

Century Direct Current Motors are built in sizes from ¼ to 100 horse power.

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MOTOR GENERATOR SETS, ROTARY CONVERTORS, FANS AND VENTILATORS

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with gas is the economical way . . . shrinkage is held to the minimum through temperature-and humidity-control. Uniformity of heat, too, means uniformity of flavor, color, and tastiness in the finished product. Write for the new free book "Gas Heat in Industry".

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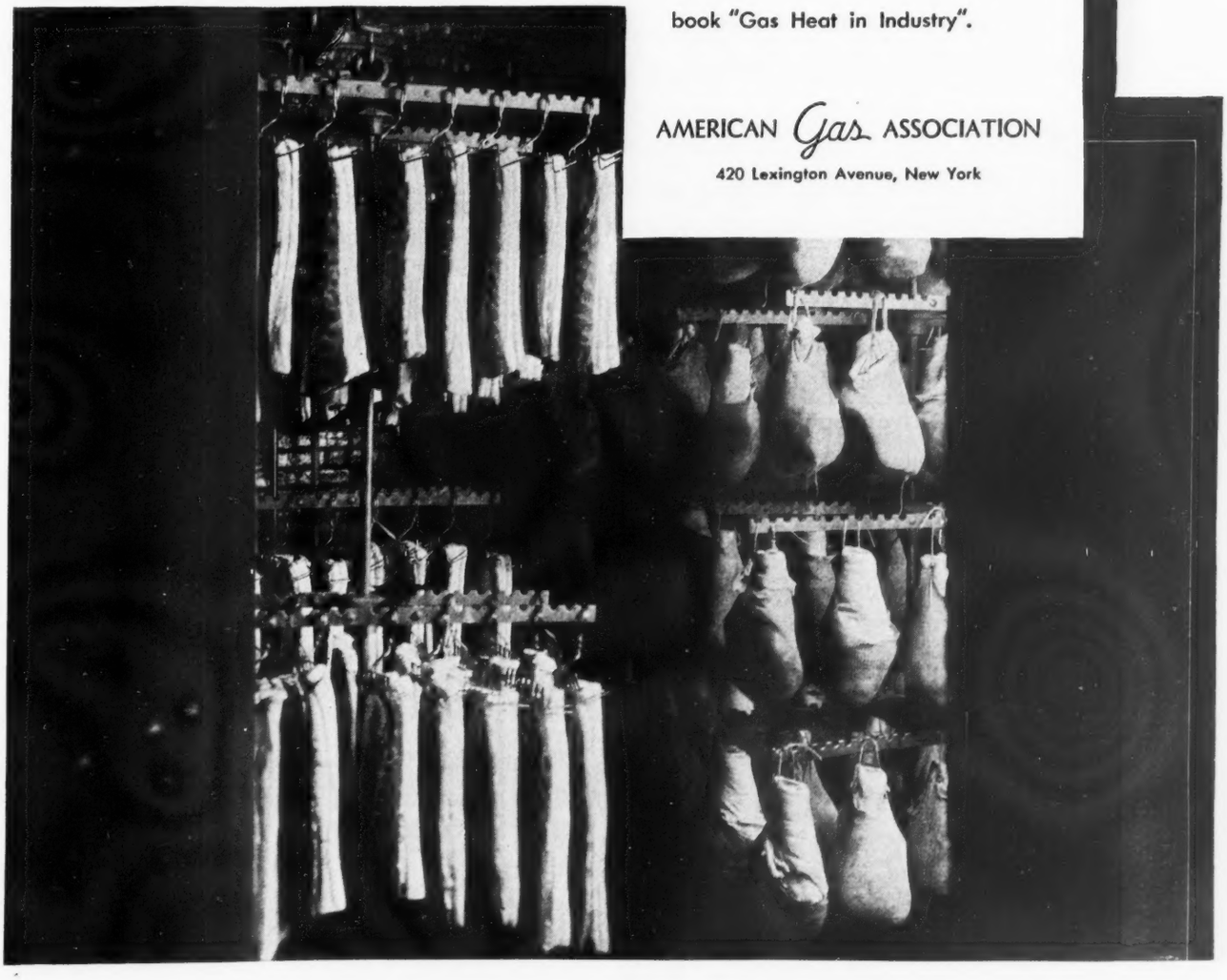
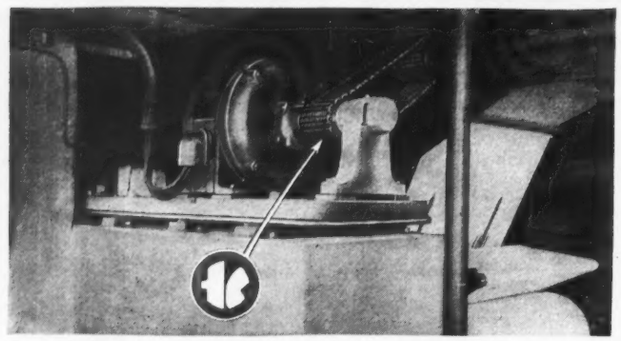


STEADY POSITIVE OPERATION



100 H. P. Morse Chains driving from motor to printing press equipped with Cutler Hammer Control at the Houston Press, Houston, Texas.

Breakdowns, failures, and necessity for frequent adjustment of power transmission equipment have no place in today's production program. Morse Chains require little care. They are adaptable to extremely short centers. They can be easily lengthened or shortened to meet **your** specifications. They cannot slip. Service records of Morse Chain Drives show remarkably long life—free from production interruptions—under the most strenuous operating conditions. Users frequently say "Our Morse Drives require practically no attention except oiling." If you are looking for freedom from power drive troubles, use Morse. Our engineering department is at your service.

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Manufacturers of Morse Chain Drives
Flexible Couplings and Speed Reducers

MORSE CHAIN DRIVES

It doesn't require much space

Economy of floor space—positive, steady, continuous flow—long, trouble-free service—cleanliness and sanitation—these are features that identify the PERFECTION Rotary Pump, the ideal pump for the food industries. Helical gears are the outstanding feature in the Perfection Pump. The teeth of the helical gears shear through the liquid on an angle instead of splashing through head on. The adaptation of the helical gear principle provides a smooth, continuous flow of liquid and eliminates excessive churning.

Easy to clean, due to highly finished inside surfaces. Built of iron or bronze. Unrivalled for pumping milk, cream, brine, molasses—hundreds of liquid food products.

PERFECTION
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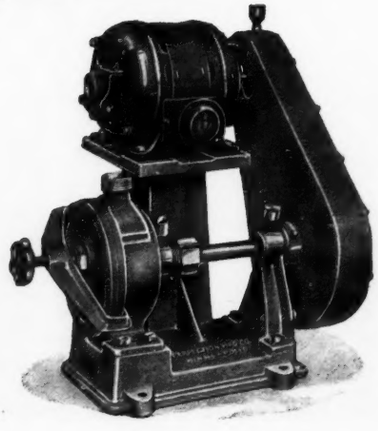
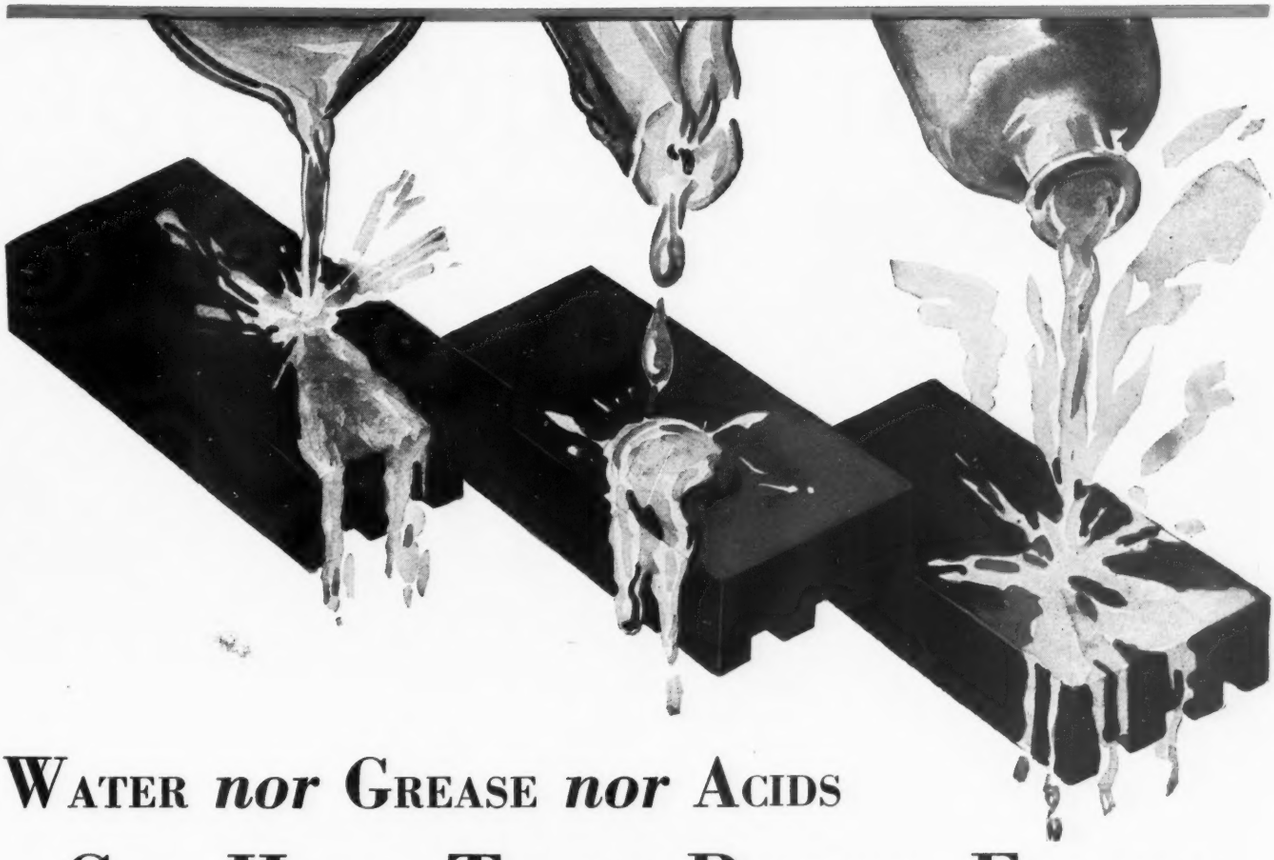
PERFECTION ROTARY PUMPS





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CAN HARM THESE BETTER FLOORS

Duratyle is the ideal flooring for the food processing plant. It is hard surfaced, non-porous and tough. It is acid proof; unaffected by grease or oil, live steam, heat, cold, flushing waters or cleaning fluids. And it is wear-proof . . . even constant trucking over it cannot wear holes or ruts, cannot crack its hard, tough surface.

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First cost is last and only cost when you lay Duratyle floors. Duratyle is the economical floor because it is the permanent floor.

Send for comparative cost figures and more details.

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DREHMANN PAVING & CONSTRUCTION CO.

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DURATYLE

A Four Hours' Job

Finished in 35 minutes

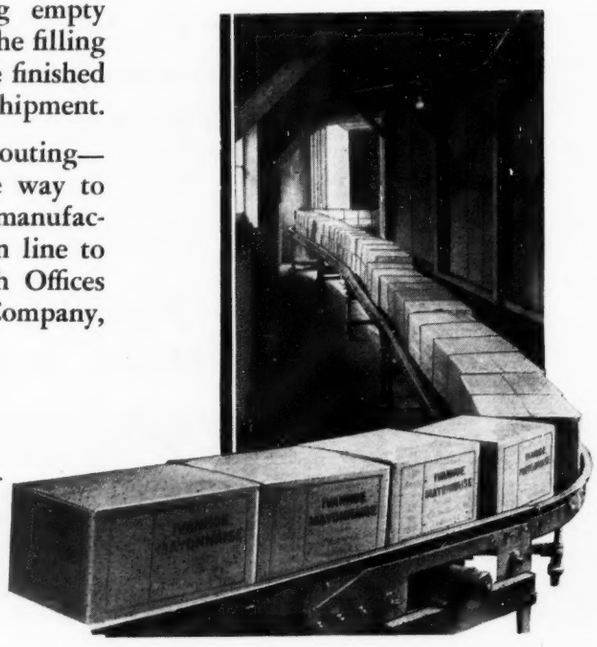
The lower conveyor in the top illustration is shown taking empty cartons to the packers. Filled cartons return on the top belt for sealing and shipping.

IT TOOK four hours to load a freight car with Ivanhoe Mayonnaise four years ago. Today—with no increase in man-power—it requires but thirty-five minutes . . . a saving of three hours and twenty-five minutes on each car.

This is but one of the economies that are daily being effected by Lamson Conveyors in the plant of Ivanhoe Foods, Inc., Auburn, New York. Savings equally great might be cited for other operations . . . the unloading from the cars of the cartons containing empty glasses . . . the movement of materials to the filling machines . . . the packing in cartons of the finished products and their steady flow into the cars for shipment.

Lamson Engineers—specialists in industrial routing—have uncovered hidden losses and pointed the way to greater profit for many of America's leading manufacturers. They will gladly study your production line to see what savings conveyors can make. Branch Offices are located in principal cities. The Lamson Company, Syracuse, New York.

Cartons of mayonnaise flow from stock to freight cars, in a steady stream over Lamson Conveyors.



THE LAMSON COMPANY
Syracuse, New York

Offices in all Principal Cities

LAMSON
CONVEYORS

The FIELDS ARE GREEN AGAIN

SPRING again has come to the Missouri Valley, unmindful of the echoes of depressions, untroubled by worry, undisturbed by human uncertainties.

Spring brings growing things to the Valley every twelve months — new growth and new wealth, a fresh start for crops and men and hopes.

For hundreds of miles in every direction from Kansas City the fertile soil again is creating and producing as if nothing else mattered — a contagious spirit that is good for the 21 millions of us who live within a stone's throw of orchards and grain fields and pastures.

It is the annual start toward another 3-billion-dollar harvest.

Kansas City offers many advantages to the manufacturer, not the least of which is close, wholesome contact with this vast producing and consuming market.

INDUSTRIAL COMMITTEE OF THE CHAMBER OF COMMERCE OF

KANSAS CITY, MO.

Industrial Committee, Chamber of Commerce,
Kansas City, Mo.:

Please send me the Book of Kansas City Facts. I am interested in the

_____ industry.

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Firm _____

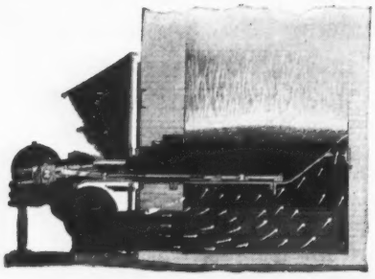
Address _____

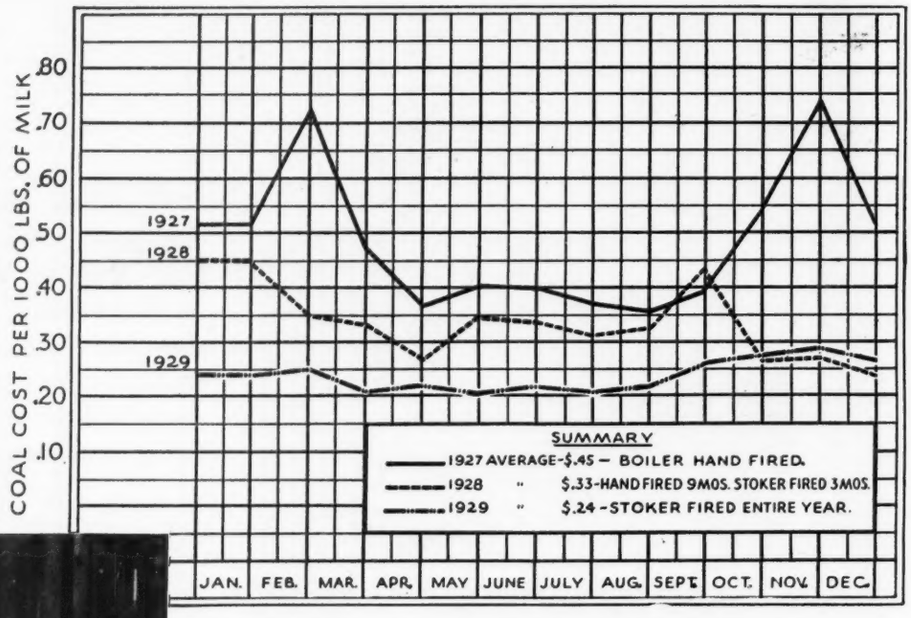
City _____ *State* _____

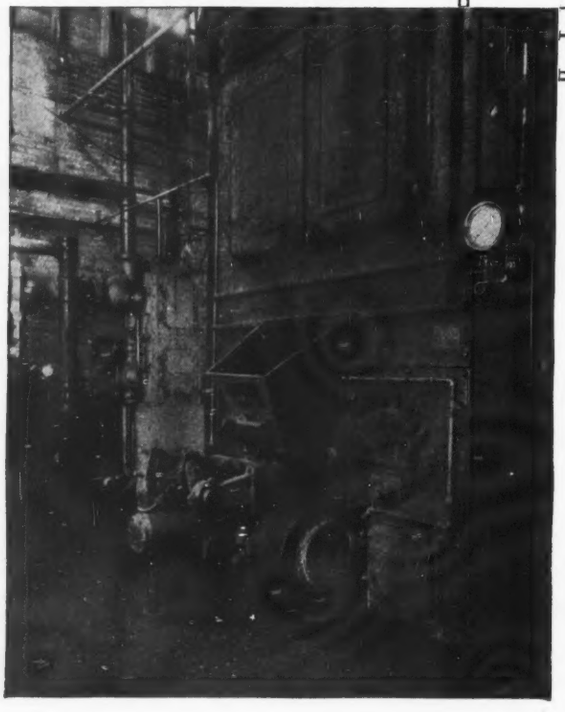
I saw your advertisement in Food Industries

46% REDUCTION in coal cost with DETROIT UNISTOKER

COAL COST PER THOUSAND POUNDS OF MILK
EQUIPMENT - ONE DETROIT UNISTOKER WITH ONE 72"X18' (168 HP)
HORIZONTAL RETURN TUBULAR BOILER







"CUT our coal bill almost in two – cut our labor bill more than in two – paid for itself in one year." ¶ These are excerpts from a letter from the president of a dairy products firm accompanying the above chart after a year's operation of a Detroit UniStoker. ¶ Here's an opportunity to cut costs with the Detroit UniStoker. ¶ Readily applicable to all types of small and medium boilers! Compact! Each boiler and stoker an individual unit consuming current only when boiler is in use! Fuel feed automatically controlled! Air supplied at all times correctly proportioned to fuel burned! Great coal saver! Permits effective use of less costly grades of coal! ¶ Cut your fuel and labor costs! Use Detroit UniStokers! Write for new descriptive Bulletin Number 646

DETROIT STOKER COMPANY
THIRD FLOOR GENERAL MOTORS BLDG., DETROIT, MICHIGAN
Works at Monroe, Michigan and St. Catharines, Ontario

18 Years of Reliable Service Behind— Prolonged Years of Even Finer Service Ahead

Commercial transportation standards are invariably set by Reo.

Eighteen years ago, Reo first introduced light, more-power-for-weight, speedier, safer, lower-cost SPEED WAGONS, and has maintained engineering dominance ever since.

Hundreds of thousands of REO SPEED WAGONS and TRUCKS have been placed in operation in 64 countries, hauling structural steel down congested Broadway, bringing Brazilian coffee to coastal shipping ports, or patrolling the vast desert stretches along the Great Wall of China!

The same story of day-in-day-out reliability and astounding infrequency of repair has travelled the world around, and has won universal acceptance for REO products.

In face of these irrefutable results, the REO is deserving of a lasting place in your system of transportation service.

REO MOTOR CAR COMPANY, LANSING, MICH.

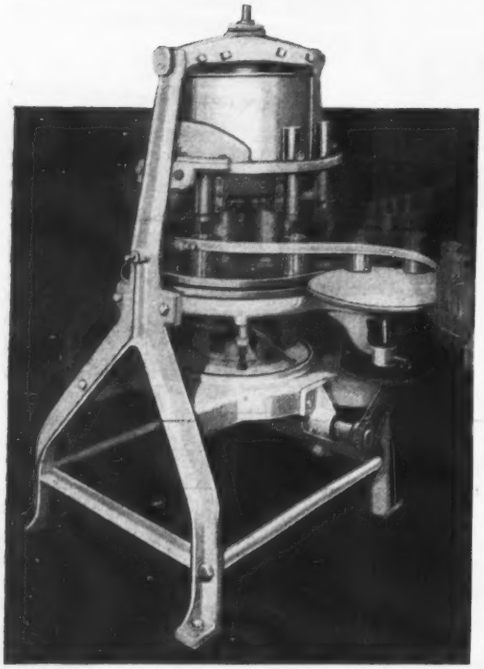
SPEED WAGONS REO AND TRUCKS

"But my filling problem is different"

That's what cheese packers, manufacturers of malt, lard, crisco babyfood, oils and other products said when we told them they needed an M&S Filler. But M&S Fillers are now filling their products uniformly, quickly and cheaply.

M&S FILLER

FILLS ALL MOIST OR VISCID PRODUCTS



The M&S is the universal filler. It fills any liquid, semi-liquid, viscous, mushy, or semi-solid mixture or material into tin, glass or paper containers,—round, square, oval, flat—small mouth or large. The same piston-forced, positively-measured feed that has made the M&S the standard filler in 600 corn canneries is the reason for its success in filling common and unusual substances in all branches of the food industry. Speed? Depending on product and container, the M&S is filling at speeds of from 90 to 200 per minute. A new model just introduced, the M&S Hi-Speed, fills small cans at 300 per minute! Cost? Special-design efficiency at mass-production price.

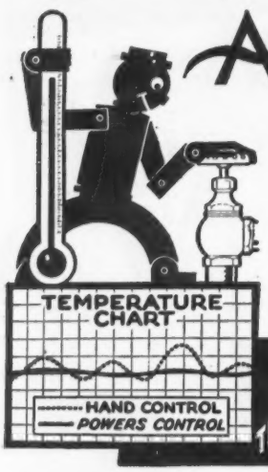
Our engineers have had long experience in overcoming just such difficult filling problems as yours. Their services might put money in your pocket. Write today describing your product and container. No obligation.

SOME USES AND USERS

Products		Users
Crushed Corn	Fruitcake	National Biscuit Co.
Pumpkin	Shortening	General Seafoods Corp.
Applesauce	Mincemeat	Cudahy Packing Co.
Condensed Milk	Chocolate Syrup	Crosse & Blackwell
Malt Syrup	Lard	Campfire Co.
Tomato Paste	Jelly	Rainier Brewing Co.
Dogfood	Jam	Procter & Gamble Co.
Soup	Relish	American Diamalt Co.
Potted Meat	Salad Oil	Chappel Bros.
Cheese	Syrup	Wm. Underwood Co.
Fishcakes	Ice Cream	Fremont Canning Co.
Marshmallow	Plum Pudding	Hershey Chocolate Co.
Chili Con Carne	Grated Pineapple	College Inn Products Co.
Babyfood	Welsh Rarebit	Swift & Co.

SPRAGUE-SELLS CORPORATION
Division of Food Machinery Corporation
300 W. WASHINGTON ST., CHICAGO, ILLINOIS

Automatic Temperature Control



TO ERR IS HUMAN—eliminate the errors of hand control of temperature with the mechanical accuracy of a Powers Regulator. It will quickly pay for itself by speeding up production—helps you to get a still better and more uniform product, and stops steam losses due to overheating. Let our engineers study your problems of temperature control and recommend the type of regulator that will give the best results at the lowest cost.

CHICAGO—2755 Greenview Ave. NEW YORK—231 E. 46th St.

THE POWERS REGULATOR CO. OFFICES IN 40 CITIES

40 YEARS OF SPECIALIZATION IN HEAT CONTROL

Now you've read this issue . . . set your own standards of comparison . . . then act . . . could you make a better reading investment . . . ?

FOOD INDUSTRIES—10th Ave., at 36th St., N. Y. C.

You look good to me. Please enter my subscription for
☐ 2 years—$3. ☐ 1 year $2. Bill me later.

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Company .....

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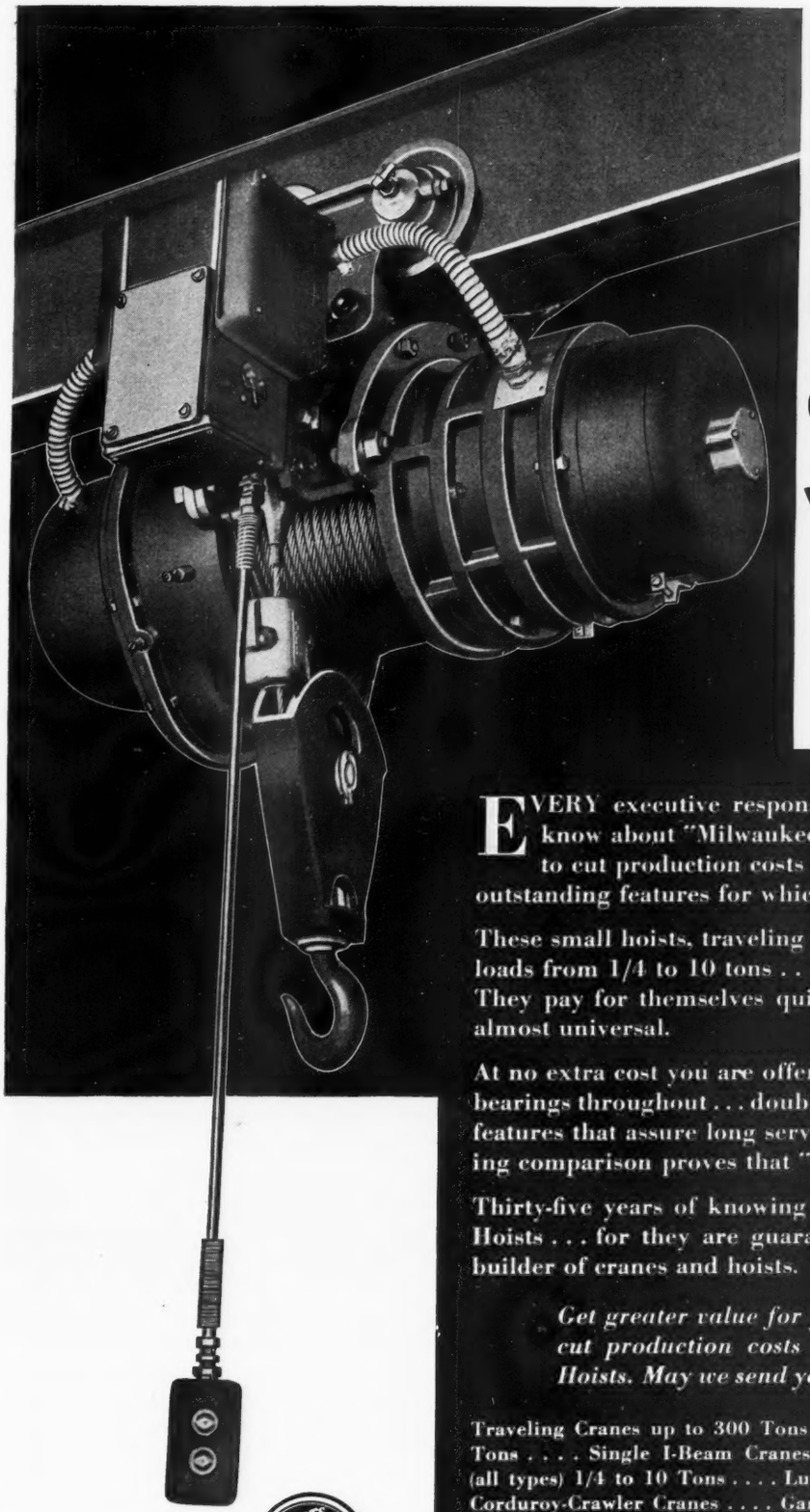


THE SHREWDEST BUYERS SEE GREATEST VALUE HERE

EVERY executive responsible for crane purchases should know about "Milwaukee" Electric Hoists . . . their ability to cut production costs . . . their moderate price . . . their outstanding features for which you pay no more!

These small hoists, traveling on an overhead monorail, handle loads from 1/4 to 10 tons . . . speedily, *safely* and at less cost. They pay for themselves quickly . . . and their application is almost universal.

At no extra cost you are offered push button control . . . roller bearings throughout . . . double drive hoist gearing . . . and other features that assure long service at lowest cost. The most exacting comparison proves that "Milwaukee" offers greatest value.

Thirty-five years of knowing how are built into "Milwaukee" Hoists . . . for they are guaranteed by P & H, world's largest builder of cranes and hoists.

Get greater value for your hoist dollar . . . and cut production costs . . . . with "Milwaukee" Hoists. May we send you a copy of Bulletin 202?

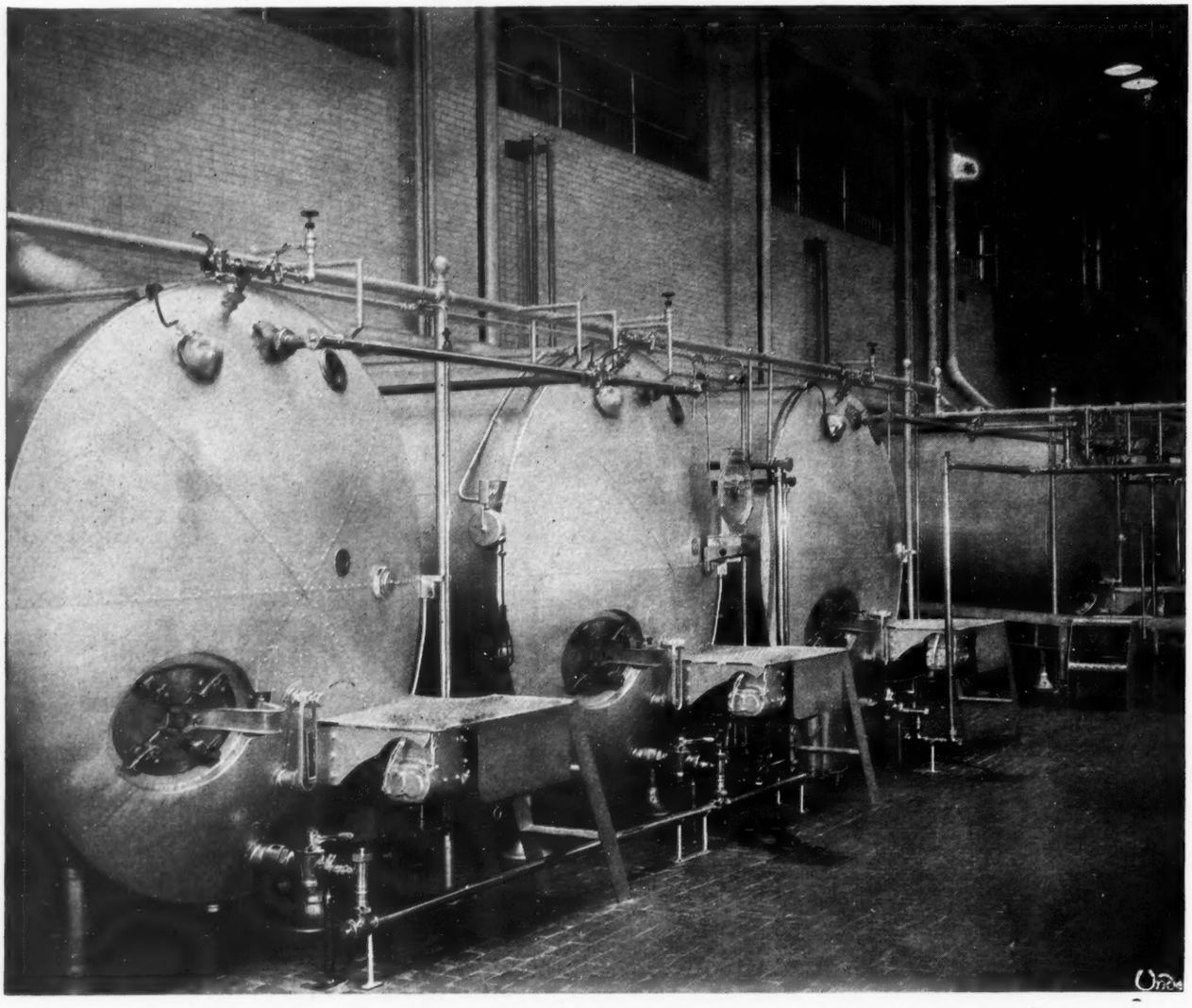
Traveling Cranes up to 300 Tons . . . . Low Headroom Cranes 3 to 30 Tons . . . . Single I-Beam Cranes 1/4 to 5 Tons . . . . Monorail Hoist (all types) 1/4 to 10 Tons . . . . Lumber Cranes . . . . Bucket Cranes . . . . Corduroy-Crawler Cranes . . . . Gantry Cranes . . . . Single Line Buckets.

HOISTS MILWAUKEE CRANES ROLLER BEARING CRANES

Milwaukee Electric Crane & Hoist Division of
HARNISCHFEGER CORPORATION
4507 W. National Ave., Milwaukee, Wisconsin

MILWAUKEE

FOR BOWMAN'S MAGNIFICENT RIVER FOREST PLANT PFAUDLER HAS FURNISHED GLASS LINED TRANSPORTATION, STORAGE AND HOLDING EQUIPMENT IN EXCESS OF 60,000 GALS.!



Section of raw milk storage department at the new River Forest, Ill., plant of Bowman Dairy Co., showing six Pfaudler glass lined storage tanks of 4000 gals. capacity each.

Pfaudler congratulates Bowman on its new achievement!

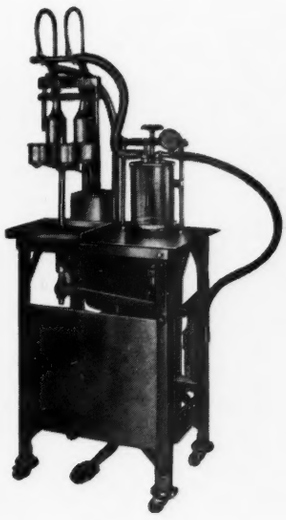
In having been privileged to equip this great plant with glass lined steel transportation, storage, and holding equipment, Pfaudler is naturally gratified.

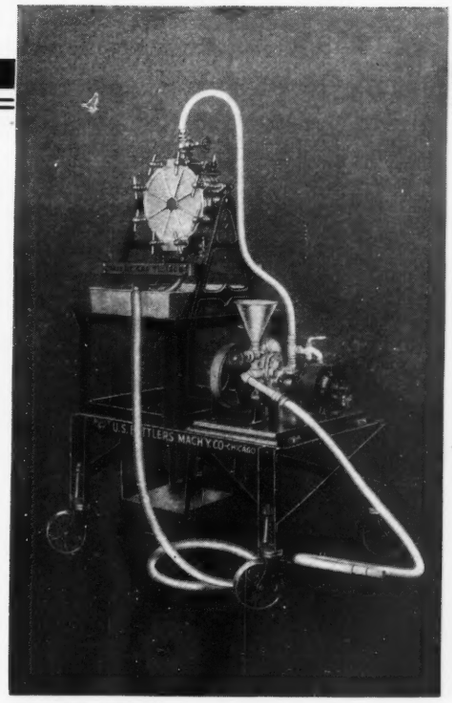
We believe the placement of such a large order with us is conclusive evidence of the many practical advantages which glass lined steel equipment offers any modern dairy operator.

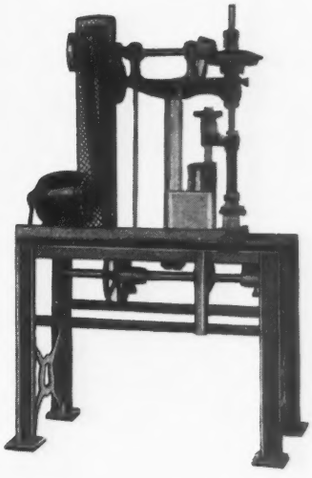
Bowman uses Pfaudler equipment in all its plants and has done so for the past 12 years!

THE PFAUDLER COMPANY, 1510 Gas & Elec. Bldg., Rochester, N. Y.

PFAUDLER







SEE THESE MACHINES AT THE CHEMICAL EXPOSITION

Grand Central Palace — New York — May 4th to 9th

SPACES No.
265 and 266

When you visit the Exposition, bring your finishing plant problems with you, be they large or small. One of the most interesting features of the U. S. Bottlers Machinery Company's exhibit will be the display of famous products handled by U. S. Equipment of one kind or another. There are internationally known names among them in the food industry, pharmaceutical and chemical fields, etc. Manufacturers of a host of products such as preserves, pickles, mustards, mayonnaise, vinegars, sauces, tomato juice cocktail, and many others have found the correct answer to their filling and finishing problems by consultation with U. S. Engineers. Those in attendance at Spaces 265 and 266 will be glad to show you how washing, drying, filtering, filling, corking, capping, conveying, and kindred problems have been solved in plants of a nature similar to your own.

U.S. BOTTLERS MACHINERY CO. INC.

Bottling and Packaging Engineers

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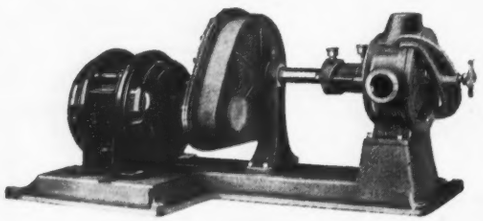
VIKING
Sanitary
ROTARY
PUMPS



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Sanitary — All surfaces smoothly machined . . impossible for bacteria to lodge and breed. Approved by National and all State Boards of Health.

Simple — Viking has just two moving parts . . which may be disassembled . . sterilized . . and reassembled in just a few minutes time with a pair of hands as the only tool.

Speedy — The Viking will deliver just as many G.P.M.'s as any other pump of the same rated gallonage . . and do it with less power and slower speed. Pumps with smooth, constant flow . . without churning, pounding or splashing.

Sturdy — The Viking is as sturdy as the name it bears. It has always been noted for its long life . . low power requirements . . and freedom from repair and service expense.

Get the complete Viking facts. Write today for FREE Catalog and Special Food Plant Bulletin.

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***of* DELAWARE**
CEDAR FALLS, IOWA

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Unit Spray-Drying

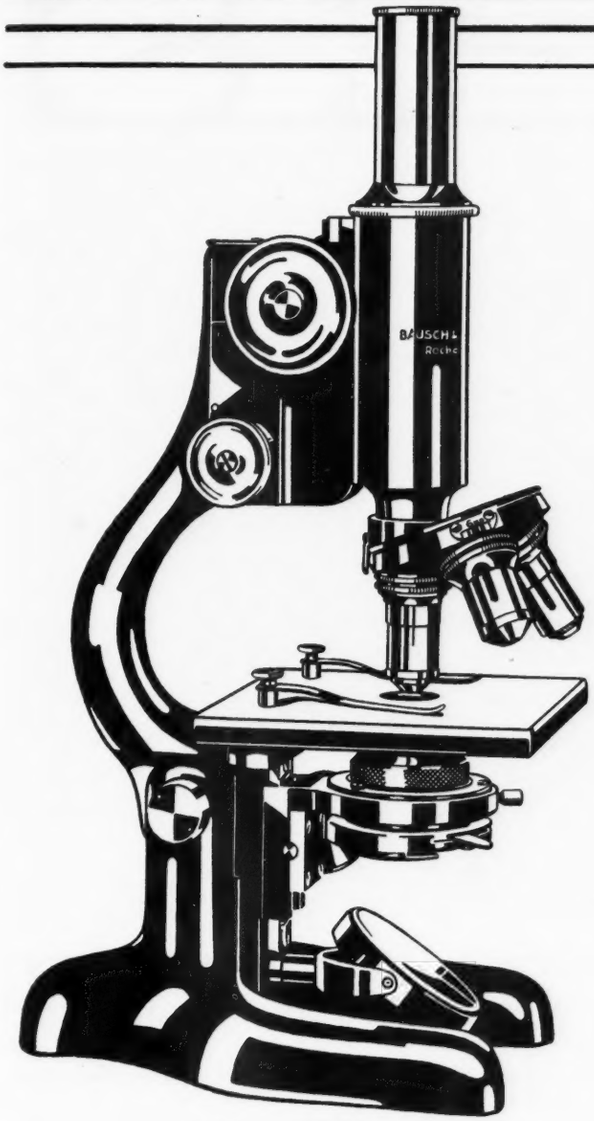
Take an old product and make it new by Unit Spray-Drying. You can do this easily and at moderate first cost. Your initial capital risk will not be great and your equipment can grow with the market for your product . . . *Now a New Product with a New Market.*

High speed, motor driven disc atomizers are used in our Unit Spray Driers. These atomizers are simple, have a long life, and will atomize anything that can be pumped through an 1½" pipe. Sludges, slurries, solutions, suspensions . . . are all alike to these atomizers. Fibres make no difference either. A valuable *New Product* awaits you.

We will gladly furnish additional information about UNIT SPRAY DRIERS if you will write us.

UNIT SPRAY DRIERS
TYPE A $7500
F. O. B. Garwood, N. J.

BOWEN RESEARCH CORPORATION,
117 LIBERTY STREET, NEW YORK



Microscope FFS

Write for information.

Microscopic Examination—

the Basis of Laboratory Control » » »

THE strength and purity of raw materials, the causes of defects in finished or semi-finished products and many other important points are clearly revealed by the powerful eye of the microscope. Microscopic examination is invaluable in setting and maintaining those standards so essential to the production of a uniformly high grade product.

The B & L FFS Microscope is most useful in the chemical laboratory. Built by Bausch & Lomb, America's leading optical institution, the FFS represents the finest skill in microscope design and building. Its magnifications and accessories are well suited for the examination of food products; its results are thoroughly reliable.

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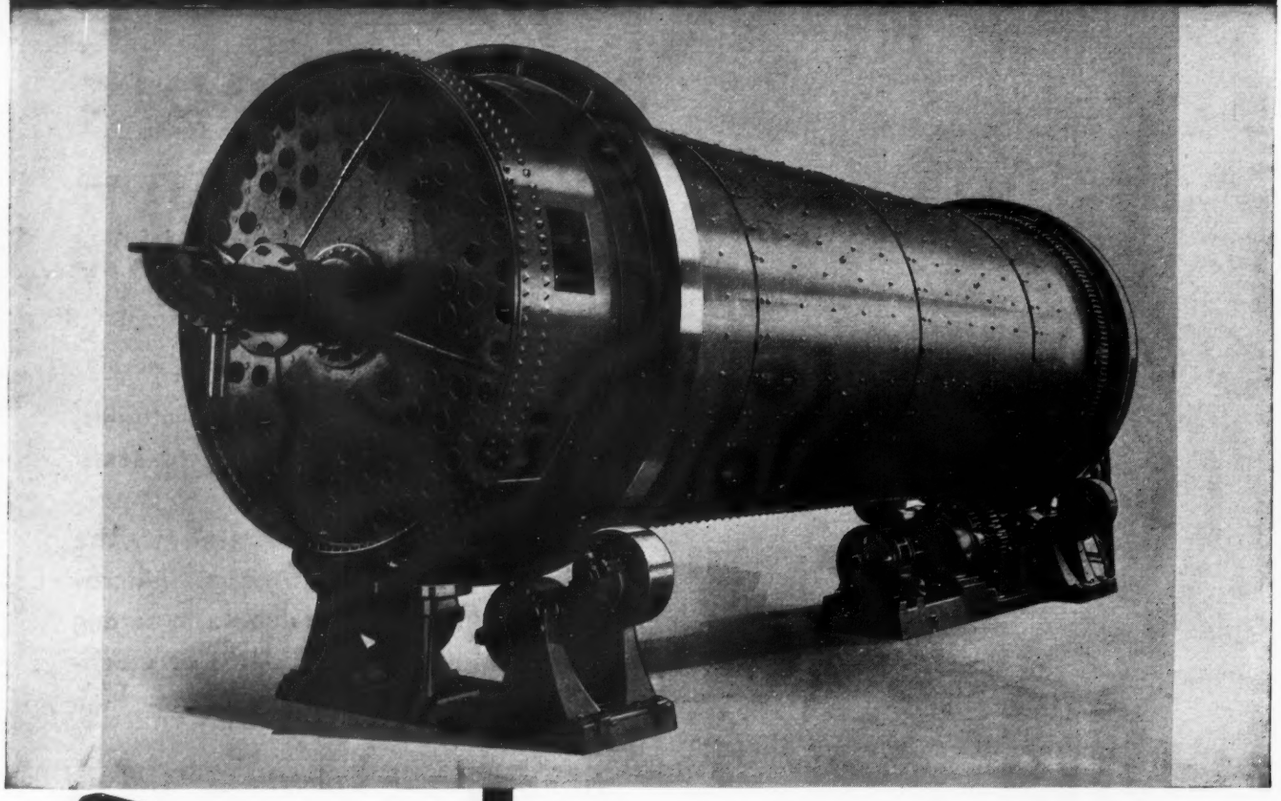

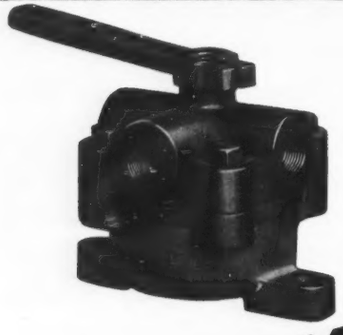

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FOR air, water, gas, oil and other fluids, Galland-Henning NOPAK Valves are unexcelled.

Will not stick. No contamination of fluids from valve lubricants. Leakless valve seats protected at all times. Discs definitely sealed whether Valve is closed or in operating position. Permits throttling. Easy to operate. No packing. No tapered plugs.

In standard Straightway, 3-Way and 4-Way styles, NOPAK Valves (no packing) made from ¼" to 2" pipe openings. Write for bulletin.

Increase Drying Capacities and Lower Costs . . . with this Modern Equipment

Improved uniform product—increased capacities under all climatic conditions—lowered fuel and power costs — negligible maintenance — these are the guarantee offered by Galland-Henning's 41 years of experience in building and installing all types of Rotary Continuous and Batch Dryers . . . Complete engineering service available to give every job special attention—Let us figure with you on possible equipment, regardless of tonnage requirement.

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2705 South 31st Street Milwaukee, Wisconsin

Outline your dryer needs.
Complete bulletins and blue prints available on request.

A SPECIAL PAINT

to resist each severe condition in the Food Industry . . .

CHEESMAN-ELLIOT CO. has developed special paints which combat the enemies to long service most commonly found in Food plants.

Newlite Heat Resisting White is of particular value in bakeries, kitchens, or other places where heat rapidly discolors ordinary white finishes. Its unusually low odor eliminates the possibility of contaminating food products by the odor of drying paint.

Newlite Damp Resisting Flat White withstands heavy moisture, condensation or "sweating," better than other white finishes. It is also made on a special formula which contains ingredients toxic to the lower forms of plant life. Fungi, mold, mildew or smut will not attach themselves to surfaces to which this paint is applied.

Newlite Fume Resisting White possesses remarkable resistance to the discoloring action of chemical fumes and remains white even under severe conditions. After tests, the chemical laboratories of Harvard, Yale and New York Universities were finished in Newlite Fume Resisting White and other CE-CO Technical Paints.

Newlite Refrigeration White is of particular value for use in cooling rooms, refrigeration plants, food establishments and other places where the odor of ordinary paint is objectionable and where low temperatures exist.

Send for CE-CO Bulletin No. 8, which describes these paints in detail. A copy will be forwarded gladly, without obligation.

CHEESMAN-ELLIOT CO., Inc.

Established 1876

TECHNICAL PAINT MAKERS

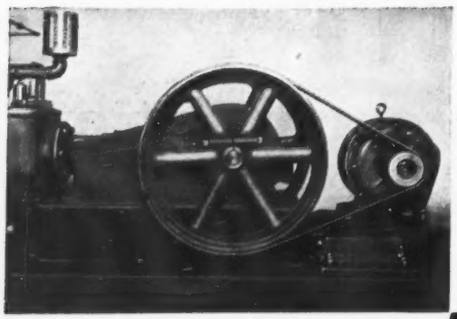
639-647 Kent Avenue, Brooklyn, N. Y.

CE-CO
Special Paints for the Food Industry

- Newlite Interior White
- Newlite Fume Resisting White
- Newlite Heat Resisting White
- Newlite Damp Resisting Flat White
- Newlite One Coat White, Sheen Finish
- Bituseal Interior Undercoat, for oil- or grease-stained surfaces
- CE-CO Dado Enamel
- CE-CO Engine Enamel
- CE-CO Pipe Enamel
- CE-CO Cement Floor Enamel
- Cecoloid Enamel

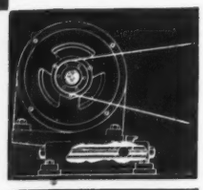
and many others

SPECIAL PAINTS FOR THE FOOD INDUSTRY



The hinge principle of the Rockwood Drive keeps belt tension constant at all times.

Single stage air compressor 6"x5". Motor 10 H.P., 1800 R.P.M. Driven pulley 28"x5". Motor pulley 5½" diam. x 4½" face. Distance between centers 25".



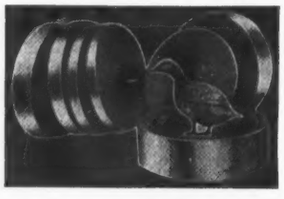
Should a 10 H. P. compressor drive cost MORE than $39.80?

Let's not mention what you would pay for some compressor drives but what you get for $39.80 in THIS compressor drive. The price covers a 10 H. P. Rockwood Drive, including motor base, motor pulley and a DUXBAK LEATHER BELT.

The high efficiency and low cost of the Rockwood Short Center Flat Belt Drive make it economical as a replacement or a new installation. Let us send you details and prices covering the 6 standard stock sizes equipped with DUXBAK LEATHER BELTING. Your request incurs no obligation.

Among the things your $39.80 buys are these:

Automatic take-up . . . Less than 1½% slip . . . Short centers . . . Extreme simplicity . . . Standardized design . . . A flat belt drive . . . A hinged and swinging motor base that compensates for all load variations AUTOMATICALLY



DUXBAK LEATHER BELTING

NOW is the time to find out how to reduce power transmission costs. Duxbak Leather Belting and the new Rockwood Drive offer certain definite advantages that are worthy of investigation.

DUXBAK BELTING TRADE MARK

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Belt Manufacturers
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CHAS. A. SCHIEREN COMPANY OF CANADA
711 St. James Street, Montreal, P. Q.
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CHAS. A. SCHIEREN COMPANY
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Send me a copy of folder describing the new Rockwood Short Center Drive.

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Position.....

Company.....

Address.....

FUMIGATE

BEFORE OR AFTER PACKING YOUR PRODUCT

In either instance the fumes of this powerful agent penetrate into the remotest corners, cracks and crevices, into containers and cases.

LARVACIDE (Chlorpicrin) REGISTERED

. . . the ideal fumigant

Instantly kills roaches, flys, pests, vermin, rodents. All stages of life from egg to adult. Your plant and your product deserve the most thorough fumigation at regular intervals. Inquire about our "Control Method" and its economy.

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RECORDERS
DIAL-INDICATING THERMOMETERS
CONTROLLERS
OIL-TESTING INSTRUMENTS
A Business Builder —and Easy to Use!
THE efficiency of any refrigerating device depends on (1) the running and idling time of the motor, and (2) the temperature of the brine or of any compartment. The TAG Portable Temperature and Time-Operation Recorder combines thes two records on the same chart. Every maker and seller of frozen products is interested, primarily, in satisfying the consumer, and he knows that goodness can be ruined by varying temperatures.
The TAG Portable Temperature and Time-Operation Recorder and other instruments for refrigerating devices are fully described in Bulletin No. 983-A. Send for your copy.
C. J. TAGLIABUE MFG. CO.
PARK AND NOSTRAND AVES., BROOKLYN, N. Y.
Instruments for Indicating, Recording and Controlling
TAG TAGLIABUE MFG. CO. BROOKLYN
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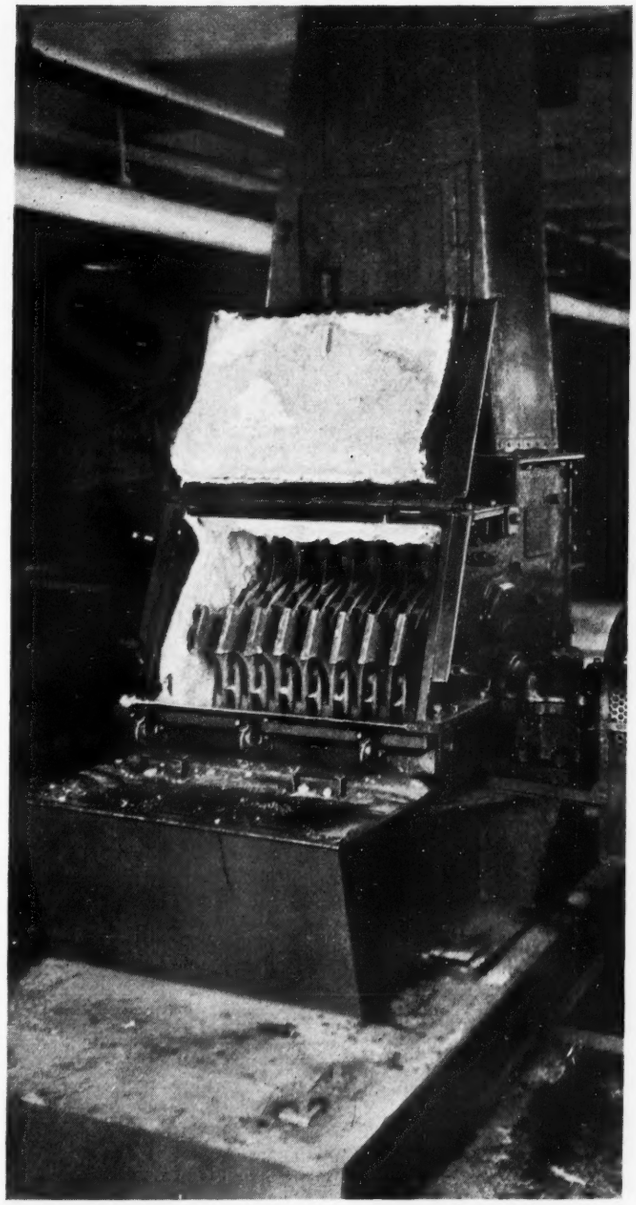

The above is an installation of a Jeffrey Rigid Hammer Shredder used in a large refinery for eliminating the smear lumps in soft sugar. A superior product is produced by the use of this machine. This is only one of the many food plant uses for which Jeffrey Pulverizers and Shredders have been found excellent.

JEFFREY
PULVERIZERS and SHREDDERS

Now Used in Food Plants on 32 Different Materials

Speed, economy and thoroughness characteristics of Jeffrey Swing Hammer Pulverizers and Shredders, and Jeffrey Gut Hashers, have appealed widely to managers of food plants.

Materials listed below, are now being handled in these Machines. Many difficult reducing problems have been solved.

If you have a problem of pulverizing or shredding any material—call in a Jeffrey Engineer. They have had the experience to assist you.

Algaroba Beans
Apples—for cider and vinegar
Bone
Bread—stale
Cabbage for brant juice
Castor Beans
Cocoa Beans
Cocoa Cake
Cocoa Hulls
Cocoanut Shells
Cottonseed Cake
Cracklings
Egg Shells
Gelatin—dry
Ginger Root
Hoofs
Horns
Kelp
Linseed Cake
Lemon Peel
Meat Cake
Meat Scrap
Orange Peel
Oyster Shells
Sugar
Sugar Cane
Salt
Skulls
Tankage
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Elevators—Conveyors
Trolley Conveyors
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Crushers—Pulverizers
Sand & Gravel Handling, Washing and Screening Equipment
Locomotives

JEFFREY
MATERIAL HANDLING EQUIPMENT

THIS VALVE HAS BOTH

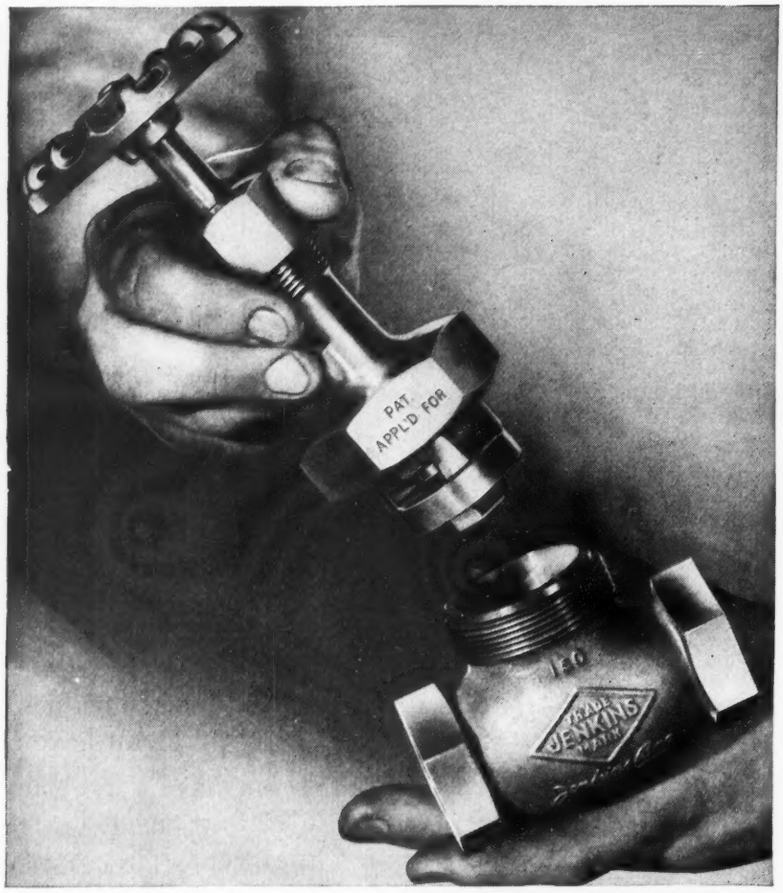


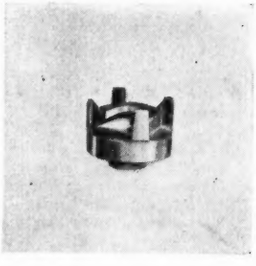
FIG. 106-A, *Screwed, Jenkins Standard Bronze Globe Valve, with one-piece screw-over bonnet, and slip-on stay-on disc holder. For 150 lbs. steam working pressure, or 250 lbs. oil, water, gas working pressure.*

One-piece screw-over bonnet.

ONE-PIECE screw-over bonnet . . . slip-on stay-on disc holder . . . Fig. 106-A is the Jenkins Standard Bronze Globe Valve that has *both*.

Fig. 106-A also has unusual strength . . . a result of its unique construction. It has every Jenkins mechanical refinement of design and manufacture. It has a fine finish that proclaims its inherent quality . . . and it has the praise of engineers and other valve users.

Fig. 106-A will win your approval, too. Its one-piece screw-over bonnet and slip-on stay-on disc holder are advantages obtainable also in Jenkins Bronze Angle and Cross Valves. Your supply house can fill your requirements. Write for a copy of Bulletin 141.



Slip-on stay-on disc holder.

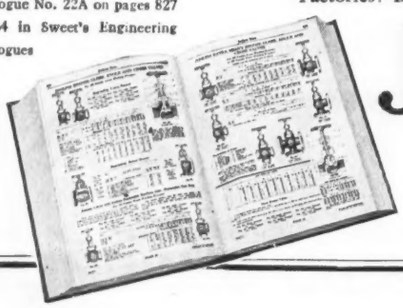
JENKINS BROS.

80 White Street, New York, N.Y. — 133 No. Seventh St., Philadelphia, Pa. — 524 Atlantic Ave., Boston, Mass. — 646 Washington Blvd., Chicago, Ill. — 1121 No. San Jacinto, Houston, Texas

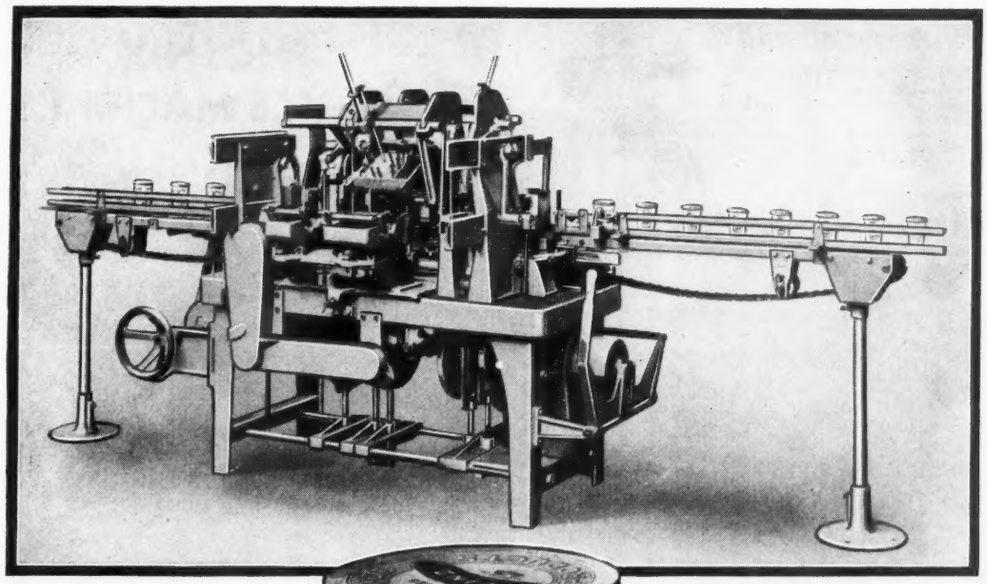
JENKINS BROS., Limited, Montreal, Canada; London, England

Factories: Bridgeport., Conn.; Elizabeth, N. J.; Montreal, Canada

See the complete Jenkins
BOOK OF VALVES
Catalogue No. 22A on pages 827 to 864 in Sweet's Engineering Catalogues



Jenkins
VALVES
Since 1864



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Heinz Peanut Butter
made by
H. J. Heinz Company
Pittsburgh, Pa.

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This fully automatic machine is proving its worth, labeling flat, round, oval or panel bottles and jars and other packages in various sizes.

Let us show you how this outstanding machine can increase your profits.

ECONOMIC MACHINERY COMPANY

Largest Manufacturers of Labeling Machines in the World

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Up-to-date commercial and industrial refrigeration

This book brings you the answers to many questions on the theory, design, installation, operation and testing of modern refrigerating systems. It is a practical, complete handbook for operating engineers in refrigeration plants, engineers engaged in designing and installing refrigerating equipment, and the man employed in servicing household refrigerators.

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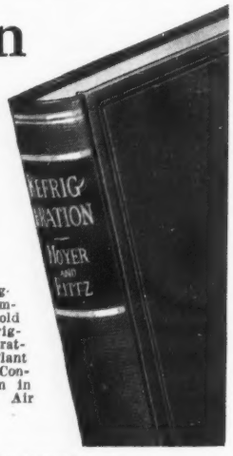
Including Household Automatic Refrigerating Machines

By JAMES A. MOYER
State Director of University Extension in Massachusetts

and RAYMOND U. FITTZ
Assistant Professor of Mechanical Engineering, Tufts College

431 pages, 6x9, illustrated, $4.00



Chapter Headings—

1. Refrigeration Methods. 2. Systems of Refrigeration. 3. Properties of Refrigerants. 4. Compressors for Refrigerating Plants. 5. Household Mechanical Refrigeration. 6. Operation of Refrigeration Systems. 7. Thermodynamics of Refrigerating Systems. 8. Refrigeration Economics and Plant Testing. 9. Ice Making. 10. Cold Storage Construction. 11. Air Circulation and Ventilation in Cold Storage. 12. Cold Storage of Foods. 13. Air Conditioning and Cooling.

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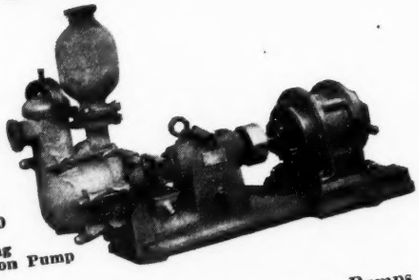

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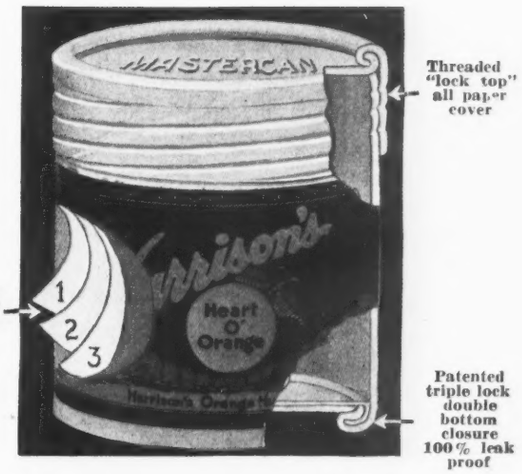

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STATEMENT OF THE OWNERSHIP, MANAGEMENT, CIRCULATION, ETC., REQUIRED BY THE ACT OF CONGRESS OF AUGUST 24, 1912

Of Food Industries, published monthly at New York, N. Y., for April 1, 1931.

State of New York } ss
County of New York }

Before me, a Notary Public in and for the State and county aforesaid, personally appeared C. H. Thompson, who, having been duly sworn according to law, deposes and says that he is the Secretary of the McGraw-Hill Publishing Company, Inc., publishers of Food Industries, and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management (and if a daily paper, the circulation), etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, embodied in section 411, Postal Laws and Regulations, printed on the reverse of this form, to wit:

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5. That the average number of copies of each issue of this publication sold or distributed, through the mails or otherwise, to paid subscribers during the six months preceding the date shown above is (This information is required from daily publications only.)

C. H. THOMPSON, Secretary.

McGRAW-HILL PUBLISHING COMPANY, INC.

Sworn to and subscribed before me this 31st day of March, 1931.

[SEAL] H. E. BEIRNE.

Notary Public N. Y. Co. Clk's No. 203, Reg. No. 3B102. Kings Co. Clk's No. 636, Reg. No. 3129. (My Commission expires March 30, 1933)

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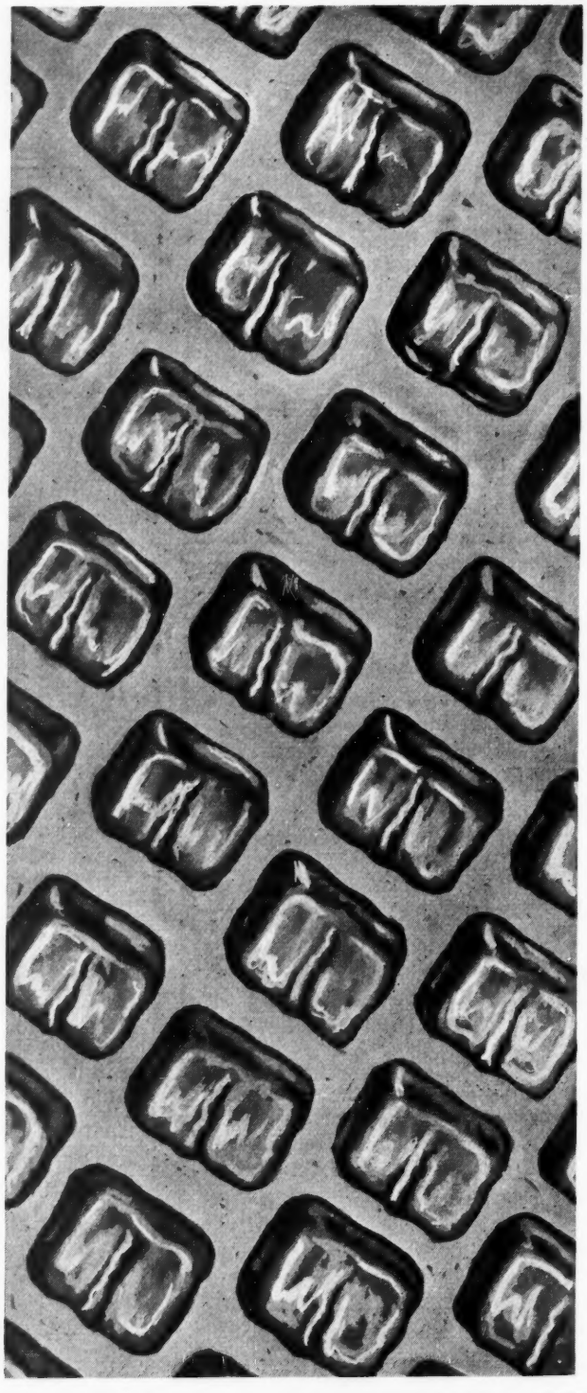
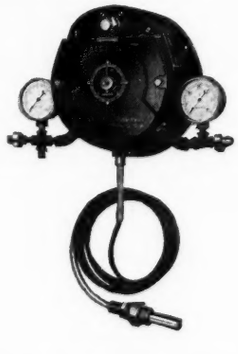


At left—Bristol Recording Thermometers are made in many types for an intelligent supervision of temperature in processes of food manufacture.

Bristol's Thermometer Controllers automatically hold temperature at predetermined range—used in pasteurizing, cooking, baking, heating, cooling, refrigerating, drying, mixing, etc.

At right—Bristol's Air Operated Control Equipment automatically maintains predetermined temperature, pressure or time. Used in connection with retorts, blanchers, cookers, peelers, sterilizers, process kettles, continuous cookers, open tanks, vats, etc.



Average Industrial Research Cost Is $44,500 A Year

The steady growth in the use of industrial research throughout the United States is illustrated by the fact that the average annual expenditure per plant for the country as a whole is now $44,500, while many individual industries exceed this average by a wide margin. The following table prepared by the National Research Council shows the average research expenditure per plant in ten of the most important industries throughout the country.

Chemical and allied products..	$105,000
Automobile	100,000
Rubber and its products.....	100,000
Metal working plants	68,300
Food and kindred products....	47,000
Paper and pulp	38,400
Textiles	20,000
Rolling mills and steel plants..	15,200
Leather and its products	15,200
Lumber and its products	13,600

Expressed in percentages, the average expense for research is found to be 1.03 per cent of the total capital invested for all concerns reporting data throughout the country. While the average is 1.03 the range was from 0.04 per cent to as high as 2.04 per cent.

Reprinted from Trends & Indications, March 10, 1931.

1931 is going to be like every other year because it will be different. Man's activities and business constantly change, and only that man or that business which can develop with the times can succeed. • Research is the surest method of adapting business to change. It is a means of accelerating experience . . . . of testing today the ideas to be used tomorrow. • In the hands of the executive who knows how to use it, research is his insurance of profits.

Reprinted from the front cover of the January Issue of FOOD INDUSTRIES

M. R. Williamson .... PUBLISHING DIRECTOR

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... and he's telling an interesting story right out of the experience of his customers—the kind of facts you want—answers from every day experience to your questions of "HOW" and "HOW MUCH."

So if you don't get your copy at the Chemical Show—if you don't meet "MIKE" there—you can have the story anyway—concise and clear—of how hundreds of "MIKE" users are saving thousands of dollars in pulverizing all kinds of substances to extreme fineness or uniform grain size without classification auxiliaries.

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Position .....

Company .....

Address .....

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• TO ADVERTISERS •

This index is published as a convenience to the reader. Every care is taken to make it accurate, but *Food Industries* assumes no responsibility for errors or omissions.

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Write to the Equipment Information Bureau of FOOD INDUSTRIES *for "where-to-buy" data on any products on which you would like further details.*

A N N O U N C I N G

.....A NEW SIFTER FOR YOUR PLANT

•

Backed by 50 years of sifter designing

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Wolf Equipment on Display

at Chemical Industries Exposition, Grand Central Palace, New York, May 4–9, and Confectioners' Exposition, Hotel Stevens, Chicago, June 1–5.

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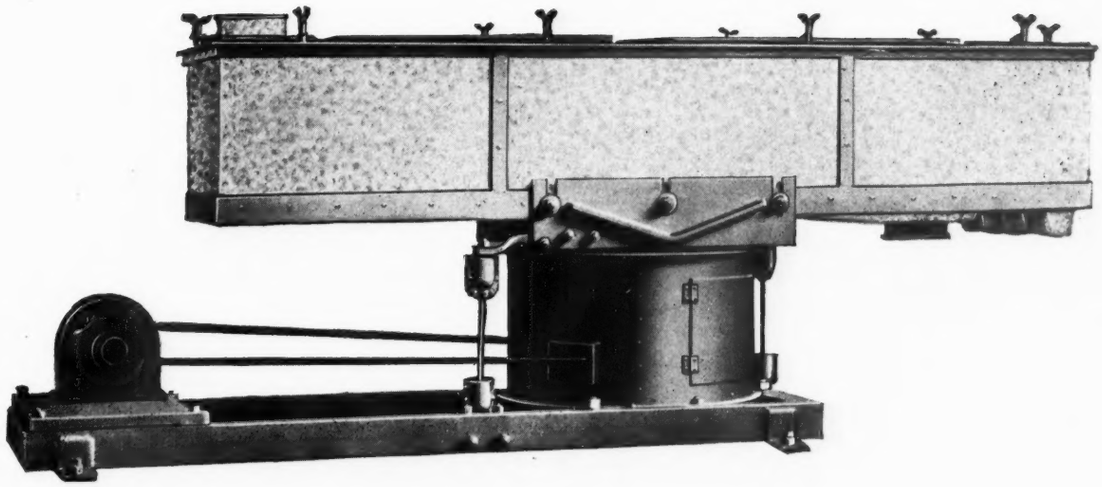


Men acquainted with various types of sifting equipment will readily appreciate the advantages and distinctive features of this new sifter.

WOLF

SUPERSIFTER

100% Circular Motion

Every point of sieve surface moves in a true circle, giving large capacity per sq. in. and maximum stratifying action.

Dynamic Balance

Don't worry about any troublesome floor vibration with this sifter. Perfect equilibrium is maintained by our simple, new driving mechanism.

Thorough Sieve Cleaning

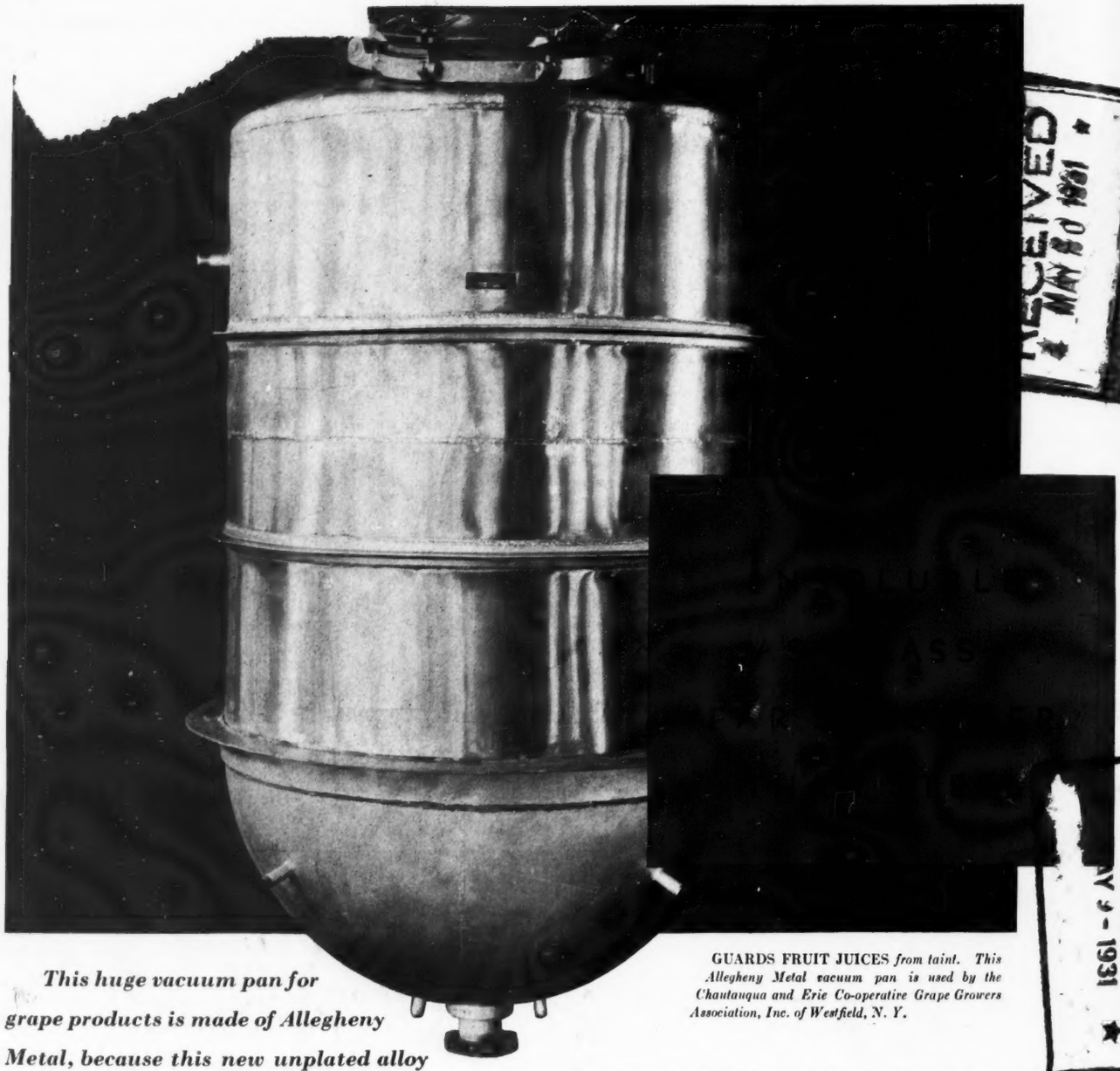
Open sieve meshes are assured by a new and extremely agile, hustling type of sieve cleaner. Its action will please you.

19 Different Machines

The Supersifter is made in sizes having from 1 to 96 sq. ft. of sieve surface, and providing 2 to 5 grades of stock.

For details ask for Bulletin—G-1.

THE WOLF COMPANY
200 Commerce St., Chambersburg, Pa.



GUARDS FRUIT JUICES *from taint. This Allegheny Metal vacuum pan is used by the Chautauqua and Erie Co-operative Grape Growers Association, Inc. of Westfield, N. Y.*

This huge vacuum pan for grape products is made of Allegheny Metal, because this new unplated alloy will not taint the product nor corrode.

"Insolubility is what the food industry needs in its equipment," a food scientist told us, "the absolute insolubility of Allegheny Metal."

Insolubility is your positive protection from any kind of taint that might render your product unsalable because of poor color or of metallic taste. Allegheny Metal is the safe alloy.

"Another point—the metal itself is not attacked by food acids. Not even the brines used in quick freezing will tarnish Allegheny Metal. That means a lifetime of service, and economy."

Other points that interest executives in the food industry are many—Allegheny Metal is far stronger than mild steel. It has strength to support itself and a heavy batch, too. It's lighter by far than some metals. It's non-magnetic. It cleans as easily as glass.

Scores of food products manufacturers now using Allegheny Metal would consider no other. Perhaps you have a severe corrosion condition to handle—write in detail and Allegheny engineers will help you apply this wonder alloy.

ALLEGHENY STEEL COMPANY, Brackenridge, Pa. *Offices:* New York, Buffalo, Chicago, Cincinnati, Cleveland, Detroit, Philadelphia, St. Louis, Milwaukee, Los Angeles. *Warehouse Stocks:* Joseph T. Ryerson & Son. Inc.—Chicago, Cleveland, Milwaukee, St. Louis, Cincinnati, Detroit, Buffalo, Boston, Jersey City, Philadelphia . . . *In Canada:* Samuel, Son & Co., Ltd., Toronto.

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ALLEGHENY METAL

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